PLANET
Networking & Communication

User's Manual

SGSD-1022 / SGSD-1022P
SGSW-2840 / SGSW-2840P

Layer 2 Managed Switches

Trademarks

Copyright © PLANET Technology Corp. 2008.

Contents subject to which revision without prior notice.

PLANET is a registered trademark of PLANET Technology Corp. All other trademarks belong to their respective owners.

Disclaimer

PLANET Technology does not warrant that the hardware will work properly in all environments and applications, and makes no warranty and representation, either implied or expressed, with respect to the quality, performance, merchantability, or fitness for a particular purpose. PLANET has made every effort to ensure that this User's Manual is accurate; PLANET disclaims liability for any inaccuracies or omissions that may have occurred.

Information in this User's Manual is subject to change without notice and does not represent a commitment on the part of PLANET. PLANET assumes no responsibility for any inaccuracies that may be contained in this User's Manual. PLANET makes no commitment to update or keep current the information in this User's Manual, and reserves the right to make improvements to this User's Manual and/or to the products described in this User's Manual, at any time without notice.

If you find information in this manual that is incorrect, misleading, or incomplete, we would appreciate your comments and suggestions.

FCC Warning

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at whose own expense.

CE Mark Warning

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

WEEE Warning

To avoid the potential effects on the environment and human health as a result of the presence of hazardous substances in electrical and electronic equipment, end users of electrical and electronic equipment should understand the meaning of the crossed-out wheeled bin symbol. Do not dispose of WEEE as unsorted municipal waste and have to collect such WEEE separately.

Revision

PLANET 8 / 24-Port 10/100Mbps with 2 / 4 Gigabit TP / SFP Combo Managed Security Switch User's Manual

FOR MODELS: SGSD-1022 / SGSD-1022P / SGSW-2840 / SGSW-2840P

REVISION: 1.0 (AUGUEST.2008)

Part No: EM-SGSD-SGSW (2080-A34050-000)

TABLE OF CONETNTS

1. INTRODUTION 23

1.1 Packet Contents 23

1.2 Product Description 23

1.3 How to Use This Manual 25

1.4 Product Features 25

1.5 Product Specification 28

2. INSTALLATION 30

2.1 Hardware Description 30

2.1.1 Switch Front Panel 30

2.1.2 LED Indications 31

2.1.3 Switch Rear Panel 35

2.2 Install the Switch 38

2.2.1 Desktop Installation 38

2.2.2 Rack Mounting 39

2.2.3 Installing the SFP transceiver 41

3. SWITCH MANAGEMENT 43

3.1 Requirements 43

3.2 Management Access Overview 44

3.3 Administration Console 44

3.4 Web Management 46

3.5 SNMP-Based Network Management 46

3.6 Protocols 47

3.6.1 Virtual Terminal Protocols 47

3.6.2 SNMP Protocol 47

3.6.3 Management Architecture 47

4. WEB CONFIGURATION 48

4.1 Main WEB PAGE 51

4.2 System.....54
4.2.1 System Information.....55
4.2.2 Switch Information.....56
4.2.3 Bridge Extension Configuration.....57
4.2.4 IP Configuration.....58
4.2.5 Jumbo Frames.....60
4.2.6 File Management.....60
4.2.6.1 Copy Operation.....60
4.2.6.2 Delete.....66
4.2.6.3 Set Startup.....66
4.2.7 Line.....68
4.2.7.1 Console Port Settings.....68
4.2.7.2 Telnet Settings.....70
4.2.8 Log.....71
4.2.8.1 System Log Configuration.....71
4.2.8.2 Remote Log Configuration.....73
4.2.8.3 Displaying Log Messages.....74
4.2.8.4 SMTP E-Mail Alert.....75
4.2.9 UPNP.....77
UPnP Configuration.....77
4.2.10 Reset.....78
4.2.11 SNTP.....79
4.2.11.1 SNTP Configuration.....79
4.2.11.2 Clock Time Zone.....80
4.2.12 LLDP.....81
4.2.12.1 LLDP Configuration.....81
4.2.12.2 LLDP Port Configuration.....83
4.2.12.3 LLDP Trunk Configuration.....86
4.2.12.4 LLDP Local Device Information.....89
4.2.12.5 Remote Port Information.....91
4.2.12.6 LLDP Remote Information Detail.....92
4.2.12.7 LLDP Device Statistics.....94
4.2.12.8 LLDP Device Statistics Details.....95

4.3 Simple Network Management Protocol.....96
4.3.1 SNMP Agent Status.....97
4.3.2 SNMP Configuration.....97
4.3.2.1 SNMP Community.....97
4.3.2.2 SNMP Trap Management.....98
4.3.3 SNMPv3.....101
4.3.3.1 SNMPv3 Engine ID.....101

4.3.3.2 SNMPv3 Remote Engine ID 102
4.3.3.3 SNMPv3 Users 103
4.3.3.4 SNMPv3 Remote Users 106
4.3.3.5 SNMPv3 Groups 108
4.3.3.6 SNMPv3 View 111

4.4 Port Management 113
4.4.1 Port Information 113
4.4.2 Port Configuration 115
4.4.3 Port Broadcast Control 117
4.4.4 Port Mirroring 119
4.4.4.1 Mirror Port Configuration 119
4.4.5 Rate Limit 122
4.4.5.1 Input Rate Limit Port Configuration 122
4.4.5.2 Output Rate Limit Port Configuration 123
4.4.6 Port Statistics 124

4.5 Link Aggregation 129
4.5.1 Trunk Information 130
4.5.2 Trunk Configuration 130
4.5.3 Trunk Broadcast Control 132
4.5.4 Trunk Membership 133
4.5.5 LACP 136
4.5.5.1 LACP Configuration 137
4.5.5.2 LACP Aggregation Port 138
4.5.5.3 Displaying LACP Port Counters 141
4.5.5.4 Displaying LACP Settings and Status for the Local Side 141
4.5.5.5 Displaying LACP Status for the Remote Side 143

4.6 Address Table 145
4.6.1 Static Addresses 145
4.6.2 Dynamic Addresses 146
4.6.3 Address Aging 148

4.7 Spanning Tree 149
4.7.1 STA 157
4.7.1.1 Spanning Tree Information 157
4.7.1.2 STA Configuration 159
4.7.1.3 STA Port Information 163
4.7.1.4 STA Port Configuration 165
4.7.2 MSTP 168
4.7.2.1 Configuring Multiple Spanning Trees 168

4.7.2.2 Displaying Interface Settings for MSTP 169
4.7.2.3 MSTP Port Configuration 170

4.8 VLAN Configuration 172
4.8.1 IEEE 802.1Q VLANs 173
4.8.1.1 VLAN Basic Information 177
4.8.1.2 GVRP Status 178
4.8.1.3 VLAN Current Table 179
4.8.1.4 VLAN Static List 180
4.8.1.5 VLAN Static Table 181
4.8.1.6 Static Membership by Port 184
4.8.1.7 VLAN Port Configuration 185
4.8.2 Q-in-Q VLAN 188
4.8.2.1 802.1Q Tunnel Configuration 191
4.8.2.2 802.1Q Tunnel Port Configuration 192
4.8.3 Private VLAN 194
4.8.3.1 Private VLAN Information 195
4.8.3.2 Private VLAN Configuration 196
4.8.3.3 Private VLAN Association 197
4.8.3.4 Private VLAN Port Information 198
4.8.3.5 Private VLAN Port Configuration 199
4.8.4 Protocol VLAN 201
4.8.4.1 Protocol VLAN Configuration 202
4.8.4.2 Protocol VLAN Port Configuration 203

4.9 Multicast 205
4.9.1.1 IGMP Configuration 206
4.9.1.2 IGMP Immediate Leave 208
4.9.1.3 Multicast Router Port Information 209
4.9.1.4 Static Multicast Router Port Configuration 210
4.9.1.5 IP Multicast Registration Table 211
4.9.1.6 IGMP Member Port Table 212
4.9.2 IGMP Filter and Throttling 214
4.9.2.1 IGMP Filter Profile Configuration 214
4.9.2.2 IGMP Filter Profile Configuration 215
4.9.2.3 IGMP Filter / Throttling Port Configuration 216
4.9.3 Multicast VLAN Registration (MVR) 218
4.9.3.1 MVR Configuration 219
4.9.3.2 MVR Port Configuration 220
4.9.3.3 MVR Port Information 222
4.9.3.4 MVR Group Member Configuration 222

4.9.3.5 MVR Group IP Information 224

4.10 Quality of Service 225

4.10.1 Priority 226

4.10.1.1 Port Priority Configuration 227

4.10.1.2 Traffic Classes 228

4.10.1.3 Queue Mode 230

4.10.1.4 Queue Scheduling 231

4.10.2 Layer 3/4 Priority Settings 232

4.10.2.1 Mapping Layer 3/4 Priorities to CoS Values 232

4.10.2.2 IP DSCP Priority Status 232

4.10.2.3 IP DSCP Priority 233

4.10.2.4 Mapping IP Precedence Priority 234

4.10.2.5 IP Precedence Priority Status 234

4.10.2.6 IP Precedence Priority 235

4.10.2.7 Mapping IP TOS Priority 235

4.10.2.8 IP TOS Priority Status 236

4.10.2.9 IP TOS Priority 237

4.10.2.10 Mapping IP Port Priority 237

4.10.2.11 IP Port Priority Status 238

4.10.2.12 IP Port Priority 239

4.10.2.13 Mapping CoS Values to ACLs 239

4.10.2.14 ACL CoS Priority 240

4.10.3 DiffServ 241

Configuring Quality of Service Parameters 241

4.10.3.1 Configuring a DiffServ Class Map 242

4.10.3.2 Policy Map 245

4.10.3.3 Service Policy 249

4.10.4 Voice VLANs 250

4.10.4.1 VoIP Traffic Configuration 250

4.10.4.2 VoIP Port Configuration 251

4.10.4.3 Telephony OUI Configuration 253

4.11 Security 254

4.11.1 User Authentication 254

4.11.1 Configuring User Accounts 254

4.11.2 Configuring Local / Remote Logon Authentication 256

4.11.3 RADIUS Settings 258

4.11.4 TACACS Settings 259

4.11.5 AAA Authorization and Accounting 260

4.11.5.1 RADIUS Group Settings 261

4.11.5.2 AAA TACACS+ Group Settings 261
4.11.5.3 AAA Accounting Settings 262
4.11.5.4 AAA Accounting Update 264
4.11.5.5 AAA Accounting 802.1X Port Settings 264
4.11.5.6 AAA Accounting Exec Command Privileges 265
4.11.5.7 AAA Accounting EXEC Settings 266
4.11.5.8 AAA Accounting Summary 267
4.11.5.9 AAA Accounting Summary 268
4.11.5.10 Authorization Settings 269
4.11.5.11 AAA Authorization EXEC Settings 270
4.11.5.12 AAA Authorization Summary 270
4.11.6 HTTPS Setting 271
4.11.7 SSH 273
4.11.7.1 Configure Secure Shell 273
4.11.7.2 SSH Server Settings 275
4.11.7.3 SSH Host-Key Settings 276
4.11.8 802.1X Port Authentication 279
4.11.8.1 Understanding IEEE 802.1X Port-Based Authentication 280
4.11.8.2 Displaying 802.1X Information 283
4.11.8.3 802.1X Configuration 283
4.11.8.4 802.1X Port Configuration 284
4.11.8.5 Displaying 802.1X Statistics 286
4.11.8.6 Windows Platform RADIUS Server Configuration 287
4.11.8.7 802.1X Client Configuration 289
4.11.9 Client Security 292
4.11.10 Port Security 293
4.11.11 Web Authentication 296
4.11.11.1 Web Authentication Configuration 297
4.11.11.2 Web Authentication Port Configuration 298
4.11.11.3 Web Authentication Port Information 298
4.11.11.4 Re-Authentication 299
4.11.12 Network Access (MAC Address Authentication) 301
4.11.12.1 Network Access Configuration 302
4.11.12.2 Network Access Port Configuration 302
4.11.12.3 Network Access MAC Address Information 304
4.11.13 Access Control Lists 306
4.11.13.1 ACL Configuration 306
4.11.13.2 Configure a Standard ACL 308
4.11.13.3 Extended ACL 309
4.11.13.4 MAC ACL 311

4.11.13.5 ACL Port Binding....314
4.11.14 IP Filter....316
4.11.14.1 Web IP Filter....316
4.11.14.2 SNMP IP Filter....317
4.11.14.3 Telnet IP Filter....318
4.11.15 DHCP Snooping....320
4.11.15.1 DHCP Snooping Configuration....321
4.11.15.2 DHCP Snooping VLAN Configuration....321
4.11.15.3 Information Option Configuration....322
4.11.15.4 DHCP Snooping Port Configuration....324
4.11.16 IP Source Guard....325
4.11.16.1 Port Configuration....325
4.11.16.2 Static Configuration....327
4.11.16.3 Dynamic Information....328

4.12 Cluster....330
4.12.1 Cluster Configuration....330
4.12.2 Cluster Member Configuration....332
4.12.3 Cluster Member Information....332
4.12.4 Cluster Candidate Information....333

4.13 Power Over Ethernet (SGSD-1022P / SGSW-2840P)....335
4.13.1 Power over Ethernet Powered Device....335
4.13.2 Power Management:....336

5. COMMAND LINE INTERFACE....339

5.1 Using the Command Line Interface....339
5.1.1 Accessing the CLI....339
5.1.2 Console Connection....339
5.1.3 Telnet Connection....339

5.2 Entering Commands....341
5.2.1 Keywords and Arguments....341
5.2.2 Minimum Abbreviation....341
5.2.3 Command Completion....341
5.2.4 Getting Help on Commands....341
5.2.5 Showing Commands....342
5.2.6 Partial Keyword Lookup....344
5.2.7 Negating the Effect of Commands....344
5.2.8 Using Command History....344
5.2.9 Understanding Command Modes....344

5.2.10 Exec Commands 345
5.2.11 Configuration Commands 346
5.2.12 Command Line Processing 347

5.3 Command Groups 348

5.4 General Commands 349
enable 349
disable 350
configure 351
show history 351
reload 352
prompt 353
end 353
exit 353
quit 354

5.5 System Management Commands 355
5.5.1 Device Designation Commands 355
hostname 355
5.5.2 Banner Information Commands 356
banner configure 356
banner configure company 358
banner configure dc-power-info 358
banner configure department 359
banner configure equipment-info 359
banner configure equipment-location 360
banner configure ip-lan 361
banner configure lp-number 361
banner configure manager-info 362
banner configure mux 363
banner configure note 363
show banner 364
5.5.3 System Status Commands 365
show startup-config 365
show running-config 367
show system 369
show users 370
show version 371
5.5.4 Frame Size Commands 372
jumbo frame 372
5.5.5 File Management Commands 373

copy....373
delete....376
dir....377
whichboot....378
boot system....378

5.6 Line Commands....379
line....380
login....380
password....381
timeout login response....382
exec-timeout....383
password-thresh....383
silent-time....384
databits....384
parity....385
speed....386
stopbits....386
disconnect....387
show line....387

5.7 Event Logging Commands....388
logging on....388
logging history....389
logging host....390
logging facility....391
logging trap....391
clear log....392
show logging....392
show log....394

5.8 SMTP Alert Commands....395
logging sendmail host....395
logging sendmail level....396
logging sendmail source-email....396
logging sendmail destination-email....397
logging sendmail....397
show logging sendmail....398

5.9 Time Commands....398
sntp client....399
sntp server....400

sntp poll 400
show sntp 401
clock timezone 401
calendar set 402
show calendar 403

5.10 Switch Cluster Commands 403
cluster 404
cluster commander 404
cluster ip-pool 405
cluster member 405
rcommand 406
show cluster 406
show cluster members 407
show cluster candidates 407

5.11 SNMP Commands 408
snmp-server 409
show snmp 409
snmp-server community 410
snmp-server contact 411
Related Commands 411
snmp-server host 412
snmp-server enable traps 414
snmp-server engine-id 415
show snmp engine-id 415
snmp-server view 416
show snmp view 417
snmp-server group 418
show snmp group 419
snmp-server user 420
show snmp user 422

5.12 Authentication Commands 423
5.12.1 User Account Commands 423
username 423
enable password 424
5.12.2 Authentication Sequence 425
authentication login 426
authentication enable 426
5.12.3 RADIUS Client 427
radius-server host 428

radius-server auth-port 429
radius-server acct-port 429
radius-server key 429
radius-server retransmit 430
radius-server timeout 430
show radius-server 431
5.13.4 TACACS+ Client 432
tacacs-server host 432
tacacs-server port 433
tacacs-server key 433
tacacs-server retransmit 434
tacacs-server timeout 434
show tacacs-server 435
5.12.5 AAA Commands 436
aaa group server 436
server 437
aaa accounting dot1x 437
aaa accounting exec 438
aaa accounting commands 439
aaa accounting update 440
accounting dot1x 440
accounting exec 441
accounting commands 441
aaa authorization exec 442
authorization exec 443
show accounting 443
5.12.6 Web Server Commands 445
ip http port 445
ip http server 445
ip http secure-server 446
ip http secure-port 447
5.12.7 Telnet Server Commands 448
ip telnet server 448
5.12.8 Secure Shell Commands 449
ip ssh server 451
ip ssh timeout 452
ip ssh authentication-retries 453
ip ssh server-key size 453
delete public-key 454
ip ssh crypto host-key generate 454

ip ssh crypto zeroize....455
ip ssh save host-key....456
show ip ssh....456
show ssh....457
show public-key....458
5.12.9 802.1X Port Authentication....459
dot1x system-auth-control....460
dot1x default....460
dot1x max-req....460
dot1x port-control....461
dot1x operation-mode....461
dot1x re-authenticate....462
dot1x re-authentication....463
dot1x timeout quiet-period....463
dot1x timeout re-authperiod....464
dot1x timeout tx-period....464
dot1x intrusion-action....465
show dot1x....466
5.12.10 Management IP Filter Commands....468
management....468
show management....469

5.13 Client Security Commands....470
5.13.1 Port Security Commands....471
port security....471
5.13.2 Network Access (MAC Address Authentication)....472
network-access mode....473
network-access max-mac-count....474
mac-authentication intrusion-action....474
mac-authentication max-mac-count....475
network-access dynamic-vlan....475
network-access guest-vlan....476
mac-authentication reauth-time....477
clear network-access....477
show network-access....478
show network-access mac-address-table....479
5.13.3 Web Authentication....480
web-auth login-attempts....480
web-auth quiet-period....481
web-auth session-timeout....481
web-auth system-auth-control....482

web-auth....482
web-auth re-authenticate (Port)....483
web-auth re-authenticate (IP)....483
show web-auth....484
show web-auth interface....484
show web-auth summary....485
5.13.4 DHCP Snooping Commands....486
ip dhcp snooping....486
ip dhcp snooping vlan....488
ip dhcp snooping trust....488
ip dhcp snooping verify mac-address....489
ip dhcp snooping information option....490
ip dhcp snooping information policy....491
show ip dhcp snooping....491
show ip dhcp snooping binding....492
5.13.5 IP Source Guard Commands....492
ip source-guard....493
ip source-guard binding....494
show ip source-guard....495
show ip source-guard binding....496

5.14 Access Control List Commands....496

5.14.1 IP ACLs....497
access-list ip....497
permit, deny (Standard ACL)....498
permit, deny (Extended ACL)....499
show ip access-list....501
ip access-group....502
show ip access-group....502
map access-list ip....503
show map access-list ip....504
5.14.2 MAC ACLs....504
access-list mac....505
permit, deny (MAC ACL)....505
show mac access-list....507
mac access-group....507
show mac access-group....508
map access-list mac....508
show map access-list mac....509
5.14.3 ACL Information....510
show access-list....510

show access-group 511

5.15 Interface Commands 511

interface 512

description 512

speed-duplex 513

negotiation 514

capabilities 515

flowcontrol 516

shutdown 517

broadcast byte-rate 517

switchport broadcast 518

clear counters 519

show interfaces status 519

show interfaces counters 520

show interfaces switchport 522

5.16 Link Aggregation Commands 524

channel-group 525

lacp 525

lacp system-priority 527

lacp admin-key (Ethernet Interface) 528

lacp admin-key (Port Channel) 529

lacp port-priority 529

show lacp 530

5.17 Mirror Port Commands 535

port monitor 535

show port monitor 536

5.18 Rate Limit Commands 536

rate-limit 537

5.19 Address Table Commands 537

mac-address-table static 538

clear mac-address-table dynamic 539

show mac-address-table 539

mac-address-table aging-time 540

show mac-address-table aging-time 541

5.20 Spanning Tree Commands 541

spanning-tree 542

spanning-tree mode 543

spanning-tree forward-time....544
spanning-tree hello-time....544
spanning-tree max-age....545
spanning-tree priority....546
spanning-tree pathcost method....546
spanning-tree transmission-limit....547
spanning-tree mst-configuration....547
mst vlan....548
mst priority....549
name....549
revision....550
max-hops....551
spanning-tree spanning-disabled....551
spanning-tree cost....552
spanning-tree port-priority....553
spanning-tree edge-port....554
spanning-tree portfast....554
spanning-tree link-type....555
spanning-tree mst cost....556
spanning-tree mst port-priority....557
spanning-tree protocol-migration....558
show spanning-tree....558
show spanning-tree mst configuration....560

5.21 VLAN Commands....562
5.21.1 GVRP and Bridge Extension Commands....562
bridge-ext gvrp....563
show bridge-ext....563
switchport gvrp....564
show gvrp configuration....564
garp timer....565
show garp timer....566
5.21.2 Editing VLAN Groups....567
vlan database....567
vlan....567
5.21.3 Configuring VLAN Interfaces....568
interface vlan....569
switchport mode....569
switchport acceptable-frame-types....570
switchport ingress-filtering....571
switchport native vlan....572

switchport allowed vlan....572
switchport forbidden vlan....573
5.21.4 Displaying VLAN Information....574
show vlan....574
5.21.5 Configuring IEEE 802.1Q Tunneling....576
dot1q-tunnel system-tunnel-control....577
switchport dot1q-tunnel mode....577
switchport dot1q-tunnel tpid....578
show dot1q-tunnel....579
5.21.6 Configuring Private VLANs....580
private-vlan....581
private vlan association....582
switchport mode private-vlan....582
switchport private-vlan host-association....583
switchport private-vlan isolated....584
switchport private-vlan mapping....584
show private-vlan....585
5.21.7 Configuring Protocol-based VLANs....586
protocol-vlan protocol-group (Configuring Groups)....586
protocol-vlan protocol-group (Configuring Interfaces)....587
show protocol-vlan protocol-group....588
show interfaces protocol-group....589
5.21.8 Configuring Voice VLANs....590
voice vlan....590
voice vlan aging....591
voice vlan mac-address....591
switchport voice vlan....592
switchport voice vlan rule....593
switchport voice vlan security....594
switchport voice vlan priority....594
show voice vlan....595

5.22 LLDP Commands....596

lldp....598
lldp holdtime-multiplier....598
lldp medFastStartCount....599
lldp notification-interval....599
lldp refresh-interval....600
lldp reinit-delay....600
lldp tx-delay....601
lldp admin-status....602

lldp notification....602
lldp mednotification....603
lldp basic-tlv management-ip-address....603
lldp basic-tlv port-description....604
lldp basic-tlv system-capabilities....605
lldp basic-tlv system-description....605
lldp basic-tlv system-name....606
lldp dot1-tlv proto-ident....606
lldp dot1-tlv proto-vid....607
lldp dot1-tlv pvid....607
lldp dot1-tlv vlan-name....608
lldp dot3-tlv link-agg....608
lldp dot3-tlv mac-phy....609
lldp dot3-tlv max-frame....609
lldp dot3-tlv poe....610
lldp medtlv extpoe....610
lldp medtlv inventory....611
lldp medtlv location....611
lldp medtlv med-cap....612
lldp medtlv network-policy....613
show lldp config....613
show lldp info local-device....615
show lldp info remote-device....616
show lldp info statistics....616

5.23 Class of Service Commands....618

5.23.1 Priority Commands (Layer 2)....618
queue mode....618
switchport priority default....619
queue bandwidth....620
queue cos-map....621
show queue mode....622
show queue bandwidth....622
show queue cos-map....623
5.23.2 Priority Commands (Layer 3 and 4)....624
map ip dscp....624
map ip port....625
map ip precedence....626
map ip tos....627
map access-list ip....628
map access-list mac....628

show map ip dscp....629
show map ip port....629
show map ip precedence....630
show map ip tos....631
show map access-list....632

5.24 Quality of Service Commands....632
class-map....633
match....634
policy-map....635
class....635
set....636
police....637
service-policy....638
show class-map....639
show policy-map....639
show policy-map interface....640

5.25 Multicast Filtering Commands....641
5.25.1 IGMP Snooping Commands....641
ip igmp snooping....641
ip igmp snooping vlan static....642
ip igmp snooping version....642
ip igmp snooping leave-proxy....643
ip igmp snooping immediate-leave....644
show ip igmp snooping....644
show mac-address-table multicast....645
5.25.2 IGMP Query Commands (Layer 2)....646
ip igmp snooping querier....646
ip igmp snooping query-count....647
ip igmp snooping query-interval....647
ip igmp snooping query-max-response-time....648
5.25.3 Static Multicast Routing Commands....649
ip igmp snooping vlan mrouter....649
show ip igmp snooping mrouter....650
5.25.4 IGMP Filtering and Throttling Commands....651
ip igmp filter (Global Configuration)....651
ip igmp profile....652
permit, deny....652
range....653
ip igmp filter (Interface Configuration)....653

ip igmp max-groups 654
ip igmp max-groups action 655
show ip igmp filter 655
show ip igmp profile 656
show ip igmp throttle interface 657
5.25.5 Multicast VLAN Registration Commands 658
mvr (Global Configuration) 658
mvr (Interface Configuration) 659
show mvr 661

5.26 IP Interface Commands 664
ip address 664
ip default-gateway 665
ip dhcp restart 666
show ip interface 666
show ip redirects 667
ping 667

6. CLI CONFIGURATION (To be Continued) 669

System 669
System Information 669
Switch Information 670
Display Bridge Extension Capabilities 670
IP Address Configuration 671
Manual IP Configuration 671
Using DHCP/BOOTP 671
Sending Simple Mail Transfer Protocol Alerts 671
Setting the System Clock 672
Setting the Time Zone 672

7. SWITCH OPERATION 673

7.1 Address Table 673

7.2 Learning 673

7.3 Forwarding & Filtering 673

7.4 Store-and-Forward 673

7.5 Auto-Negotiation 674

8. POWER OVER ETHERNET OVERVIEW 675

What is PoE? 675

The PoE Provision Process 677

Stages of powering up a PoE link 677

Line Detection 677

Classification 678

Start-up 678

Operation 678

Power Disconnection Scenarios 678

9. TROUBLE SHOOTING 680

APPENDEX A 681

A.1 Switch's RJ-45 Pin Assignments 681

A.2 10/100Mbps, 10/100Base-TX 681

APPENDEX B : GLOSSARY 683

1. INTRODUTION

The PLANET Layer 2 Managed Security Switch series - SGSD-1022 / SGSD-1022P / SGSW-2840 / SGSW-2840P are all multiple ports Fast Ethernet Switched with Gigabit uplink capability and robust layer 2 features; the description of these models as below:

SGSD-1022 : 8-Port 10/100Base-TX + 2-Port Gigabit TP/SFP Combo Managed Switch
SGSD-1022P : 8-Port 10/100Base-TX + 2-Port Gigabit TP/SFP Combo Managed PoE Switch
SGSW-2840 : 24-Port 10/100Base-TX + 4-Port Gigabit TP/SFP Combo Managed Switch
SGSW-2840P: 24-Port 10/100Base-TX + 4-Port Gigabit TP/SFP Combo Managed PoE Switch
SGSW-2840R : 24-Port 10/100Base-TX + 4-Port Gigabit TP/SFP Combo Managed Switch w/ Redundant Power

Terms of "**Managed Switch**" means the Switches mentioned titled in the cover page of this User's manual, i.e.SGSD-1022 and SGSD-2840.

1.1 Packet Contents

Open the box of the Managed Switch and carefully unpack it. The box should contain the following items:
Check the contents of your package for following parts:

☑ **The Managed Switch**	x1
☑ **User's manual CD**	x1
☑ **Quick installation guide**	x1
☑ **19" Rack mount accessory kit**	x1
☑ **Power cord**	x1
☑ **Rubber feet**	X4
☑ **RS-232 DB9 male Console cable**	x1

If any of these are missing or damaged, please contact your dealer immediately, if possible, retain the carton including the original packing material, and use them against to repack the product in case there is a need to return it to us for repair.

1.2 Product Description

Full-Functioned / Advanced Features Layer 2 Managed Switch for Enterprise and Campus Networking

The PLANET SGSD-1022 / SGSW-2840 is a 8 / 24-Port 10/100Mbps Fast Ethernet Switch with 2 / 4-Port Gigabit TP/ SFP Combo interfaces, which boasts high performance switch architecture. That is capable of providing non-blocking switch fabric and wire-speed throughput as high as 12.8 Gbps, which greatly simplifies the tasks of upgrading the LAN for catering to increase bandwidth demands. Its four built-in GbE uplink ports also offer incredible extensibility, flexibility and connectivity to the core switch or servers.

Robust Layer 2 Features

The SGSW-2840 can be programmed for basic switch management functions such as port speed configuration, Port aggregation, VLAN, Spanning Tree protocol, QoS, bandwidth control and IGMP Snooping. It provides IEEE 802.1Q Tagged VLAN and the VLAN groups allowed on the SGSW-2840 will be maximally up to 256. Via aggregation of supporting port, the SGSW-2840 allows the operation of high-speed trunk combining multiple ports. Maximum up to 8 ports can be assigned for 12 trunk groups and it supports fail-over as well.

Excellent Traffic Control

The SGSx-series Managed Switch is loaded with powerful traffic management and QoS features to enhance services offered by telecoms. The functionality includes QoS features such as wire-speed Layer 4 traffic classifiers and bandwidth limiting applications that are particular useful for multi-tenant unit, multi business unit, Telco, or Network Service Provider. It also empowers the enterprises to take full advantages of the limited network resources and guarantees the best performance in VoIP and Video conferencing transmission.

Efficient IP Stacking Management

The SGSW-2840 supports IP Stacking function that helps network managers to easily configure up to 36 switches in the same series via one single IP address instead of connecting and setting each unit one by one. For efficient management, the SGSx-series Managed Ethernet Switch is equipped with console, WEB and SNMP management interfaces. With its built-in Web-based management, it offers an easy-to-use, platform-independent management and configuration facility. It supports standard Simple Network Management Protocol (SNMP) and can be managed via any standard-based management software as well. For text-based management, the SGSx-series Managed Switch can also be accessed via Telnet and the console port. Moreover, it offers secure remote management by supporting SSL and SSH connection which encrypt the packet content at each session.

Powerful Security

The SGSx-series Managed Switc offers comprehensive Access Control List (ACL) for enforcing security to the edge. Its protection mechanism also comprises port-based IEEE 802.1x user and device authentication. The port-security is effective in limiting the numbers of clients pass through so that network administrators can now construct highly secured corporate networks with considerably less time and effort than before.

Flexibility and Extension solution

The four mini-GBIC slots are compatible with 1000Base-SX/LX and WDM SFP (Small Form Factor Pluggable) fiber-optic modules. The distance can be extended from 550 meters (Multi-Mode fiber cable) or up to 10/30/50/70/120 kilometers (Single-Mode fiber or WDM fiber cable). They are well suited for applications within the enterprises' data centers and distributions.

1.3 How to Use This Manual

This User Manual is structured as follows:

Section 2, **INSTALLATION**

The section explains the functions of the Switch and how to physically install the Managed Switch.

Section 3, **SWITCH MANAGEMENT**

The section contains the information about the software function of the Managed Switch.

Section 4, **WEB CONFIGURATION**

The section explains how to manage the Managed Switch by Web interface.

Section 5, **COMMAND LINE INTERFACE**

The section describes how to use the Command Line interface (CLI).

Section 6, **CLI CONFIGURATION**

The section explains how to manage the Managed Switch by Command Line interface.

Section 7, **SWITCH OPERATION**

The chapter explains how to does the switch operation of the Managed Switch.

Section 8, **POWER OVER ETHERNET OVERVIEW**

The chapter introduce the IEEE 802.3af PoE standard and PoE provision of the Managed Switch.

Section 9, **TROUBSHOOTING**

The chapter explains how to trouble shooting of the Managed Switch.

Appendix A

The section contains cable information of the Managed Switch.

1.4 Product Features

- **Physical Ports**

SGSD-1022

- 8-Port 10/100Mbps Fast Ethernet ports
- 2 10/100/1000Mbps TP and SFP shared combo interfaces
- RS-232 DB9 console interface for basic management and setup

SGSD-1022P

- 8-Port 10/100Mbps Fast Ethernet ports with IEEE 802.3af PoE Injector
- 2 10/100/1000Mbps TP and SFP shared combo interfaces
- RS-232 DB9 console interface for basic management and setup

SGSW-2840

- 24-Port 10/100Mbps Fast Ethernet ports
- 4 10/100/1000Mbps TP and SFP shared combo interfaces
- RS-232 DB9 console interface for basic management and setup

SGSW-2840P

- 24-Port 10/100Mbps Fast Ethernet ports with IEEE 802.3af PoE Injector
- 4 10/100/1000Mbps TP and SFP shared combo interfaces
- RS-232 DB9 console interface for basic management and setup

Layer 2 Features

- Complies with the IEEE 802.3, IEEE 802.3u, IEEE 802.3ab, IEEE 802.3z Gigabit Ethernet standard
- Supports Auto-negotiation and Half-Duplex / Full-Duplex modes for all 10Base-T/100Base-TX and 1000Base-T ports.
- Auto-MDI/MDI-X detection for each RJ-45 port
- Prevents packet loss Flow Control:
  - IEEE 802.3x FAUSE Frame flow control for Full-Duplex mode
  - Back-Pressure Flow Control in Half-Duplex mode
- High performance of Store-and-Forward architecture, broadcast storm control and runt/CRC filtering eliminate erroneous packets to optimize the network bandwidth
- 8K MAC address table, automatic source address learning and ageing
- 2Mbit embedded memory for packet buffers
- Support VLANs
  - - IEEE 802.1Q tag-based VLAN
  - - IEEE 802.1v Protocol based VLAN
  - - Q-in-Q tunneling
  - - GVRP protocol for VLAN Management
  - Up to 255 VLANs groups, out of 4041 VLAN IDs
  - - Private VLAN Edge (PVE) supported
- Support Link Aggregation
  - up to 12 trunk groups
  - up to 8 ports per trunk group with 1.6Gbps bandwidth (Full Duplex Mode)
  - IEEE 802.3ad LACP (Link Aggregation Control Protocol)
  - Cisco ether-channel (Static Trunk)
- Spanning Tree Protocol
  - STP, IEEE 802.1D (Classic Spanning Tree Protocol)
  - RSTP, IEEE 802.1w (Rapid Spanning Tree Protocol)
  - MSTP, IEEE 802.1s (Multiple Spanning Tree Protocol, spanning tree by VLAN)
- Port Mirroring to monitor the incoming or outgoing traffic on a particular port

Quality of Service

- 4 priority queues on all switch ports
- Traffic classification:
  - IEEE 802.1p CoS
  - IP TOS / DSCP / IP Precedence

- IP TCP/UDP port number

- Supports for strict priority and Weighted Round Robin (WRR) CoS policies
- Supports QoS and bandwidth control on each port
- Traffic-policing policies on the switch port

Multicast

- Supports IGMP Snooping v1 and v2
- Querier mode support
- Multicast VLAN Registration (MVR)

Security

- IEEE 802.1x Port-Based / MAC-Based Authentication
- Web Authentication
- RADIUS / TACACS+ users access authentication
- IP-Based Access Control List (ACL)
- MAC-Based Access Control List (ACL)
- Port Security

Management

- Switch Management Interface
  - Console / Telnet Command Line Interface
  - Web switch management
  - SNMP v1, v2c, and v3 switch management
  - SSH v1/v2 switch management
  - SSL v3/TLS v1 switch management
- IP Stacking management up to 36 units
- Accesses through SNMPv1, v2c and v3 security set and get requests.
- Four groups (history, statistics, alarms and events) of embedded remote monitoring (RMON) agents for network monitoring and traffic analysis
- Built-in Trivial File Transfer Protocol (TFTP) client

Power over Ethernet (SGSD-1022P / SGSW-2840P Only)

- Complies with IEEE 802.3af Power over Ethernet End-Span PSE
- Up to 8 / 24 IEEE 802.3af devices powered
- Support PoE Power up to 15.4 watts for each PoE ports
- Auto detect powered device (PD)
- Circuit protection prevent power interference between ports
- Remote power feeding up to 100m
- PoE Management
- Total PoE power budget control
- Pert port PoE function enable/disable
- PoE Port Power feeding priority
- Per PoE port power limit
- PD classification detection

1.5 Product Specification

Product	SGSD-1022	SGSD-1022P	SGSW-2840	SGSW-2840R	SGSW-2840P
Hardware Specification					
10/100Mbps Copper Ports	8-Port 10/ 100Base-TX RJ-45 Auto-MDI/MDI-X		24-Port 10/ 100Base-TX RJ-45 Auto-MDI/MDI-X		
1000Mbps Copper Ports	2		4		
SFP/mini-GBIC Slots	2, shared with Port-9 and Port-10		4, shared with Port-25~Port-28		
Switch Architecture	Store-and-Forward				
Switch Fabric	5.6Gbps / non-blocking		12.8Gbps / non-blocking		
Switch Throughput	4.16Mpps @64Bytes		9.52Mpps @64Bytes		
Address Table	8K entries				
Share Data Buffer	2 Mbits				
Flow Control	Back pressure for Half-Duplex IEEE 802.3x Pause Frame for Full-Duplex				
LED	Power, Link/Act and speed per port	Power, Link/Act, PoE and speed per port	Power, Link/Act and speed per port		Power, Link/Act, PoE and speed per port
Power Consumption	Max. 10.5 watts / 32.6 BTU	Max. 130 watts / 443 BTU	Max. 20 watts / 68.5 BTU		Max. 260 watts / 887 BTU
Dimensions (W x D x H)	330 x 155 x 43.5mm 1U height	330 x 155 x 43.5mm 1U height	430 x 178 x 44.5mm, 1U height		440 x 265 x 44mm, 1U height
Weight	1.3kg	2.0kg	2.8 KG	3.0kg	5.87 kg
Power	AC 100~240V, 50/60Hz		AC 100~240V, 50/60Hz	AC : 100~240V, 50/60Hz DC: 30~60V	AC 100~240V, 50/60Hz
Layer 2 Function					
Management Interface	Console, Telnet, SSH, Web Browser, SSL, SNMPv1, v2c and v3				
Port Configuration	Port disable/enable. Auto-negotiation 10/100/1000Mbps full and half duplex mode selection. Flow Control disable / enable				
Port Status	Display each port's speed duplex mode, link status and Flow control status. Auto negotiation status, trunk status.				
Bandwidth Control	Input Rate Limit Output Traffic Shaper Allow to configure per 10K or 1M				
VLAN	IEEE 802.1Q Tagged Based VLAN ,up to 256 VLAN groups				
Link Aggregation	Supports 12 groups of 8-Port trunk, IEEE 802.3ad LACP				
QoS	Traffic classification based on Port Number, 802.1p priority, DS/TOS field in IP Packet				

IGMP Snooping	IGMP (v1/v2) Snooping, up to 256 multicast Groups				
Access Control List	IP-Based ACL / MAC-Based ACL, up to 256 entries				
SNMP MIBs	RFC-1213 MIB-II RFC-2863 Interface MIB RFC-2665 EtherLike MIB RFC-1493 Bridge MIB RFC-2674 Extended Bridge MIB RFC-2819 RMON MIB (Group 1, 2, 3,9) RFC-2737 Entity MIB RFC-2618 RADIUS Client MIB				
Power over Ethernet					
PoE Standard	--	IEEE 802.3af Power over Ethernet / PSE	--	--	IEEE 802.3af Power over Ethernet / PSE
PoE Power Supply Type	--	End-Span	--	--	End-Span
PoE Power Output	--	Per Port 48V DC, 350mA . Max. 15.4 watts	--	--	Per Port 48V DC, 350mA . Max. 15.4 watts
Power Pin Assignment	--	1/2(+), 3/6(-)	--	--	1/2(+), 3/6(-)
PoE Power Budget	--	110 Watts	--	--	230 Watts
Standards Conformance					
Regulation Compliance	FCC Part 15 Class A, CE				
Standards Compliance	IEEE 802.3 10Base-T IEEE 802.3u 100Base-TX IEEE 802.3z 1000Base- SX/LX IEEE 802.3ab 1000Base-T IEEE 802.3x Flow Control and Back pressure IEEE 802.3ad Port trunk with LACP IEEE 802.1d Spanning tree protocol IEEE 802.1w Rapid spanning tree protocol IEEE 802.1s Multiple Spanning tree protocol IEEE 802.1p Class of service IEEE 802.1Q VLAN Tagging IEEE 802.1v Protocol VLAN IEEE 802.1x Port Authentication Network Control IEEE 802.3af Power over Ethernet, Powered Source Equipment				
Environment Specifications					
Operating	Temperature: 0 degree C ~ 50 degree C Relative Humidity: 20% ~95% (non-condensing)				
Storage	Temperature: -40 degree C ~ 70 degree C Relative Humidity: 20% ~ 95% (non-condensing)				

2. INSTALLATION

This section describes the hardware features and installation of the Managed Switch on the desktop or rack mount. For easier management and control of the switch, familiarize yourself with its display indicators, and ports. Front panel illustrations in this chapter display the unit LED indicators. Before connecting any network device to the switch, please read this chapter completely.

2.1 Hardware Description

2.1.1 Switch Front Panel

The unit front panel provides a simple interface monitoring the switch. Figure 2-1 to 2-4 shows the front panel of the Managed Switches.

SGSD-1022 Front Panel

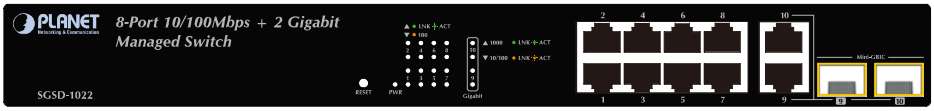


Figure 2-1 SGSD-1022 front panel.

SGSD-1022P Front Panel

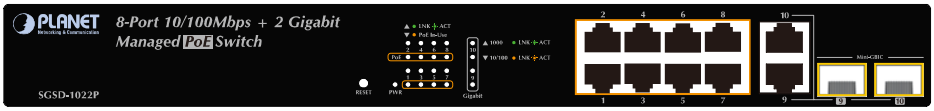


Figure 2-2 SGSD-1022P front panel.

SGSD-2840 / SGSW-2840R Front Panel

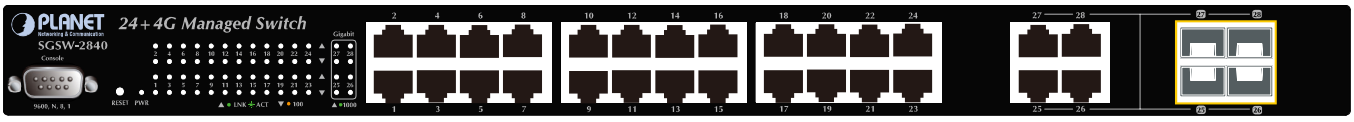


Figure 2-3 SGSW-2840 front panel.

SGSW-2840P Front Panel

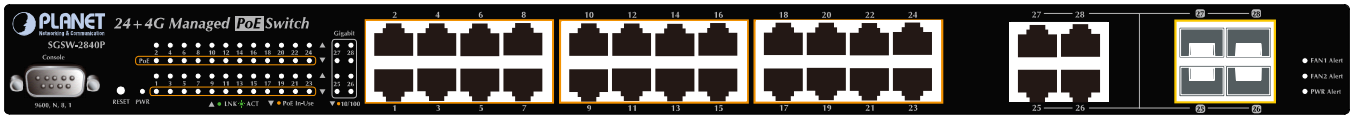


Figure 2-4 SGSW-2840P front panel.

■ **Gigabit TP interface**

10/100/1000Base-T Copper, RJ-45 Twist-Pair: Up to 100 meters.

■ **Gigabit SFP slots**

1000Base-SX/LX mini-GBIC slot, SFP (Small Factor Pluggable) transceiver module: From 550 meters (Multi-mode fiber), up to 10/30/50/70/120 kilometers (Single-mode fiber).

■ **Console Port**

The console port is a DB9, RS-232 male seria port connector. It is an interface for connecting a terminal directly. Through the console port, it provides rich diagnostic information includes factory reset, forgotten password access, network statistics, link status and system setting. Users can use the attached RS-232 cable in the package and connect to the console port on the device. After the connection, users an run any terminal emulation program (Hyper Terminal, ProComm Plus, Telix, Winterm and so on) to enter the statup screen of the device.

2.1.2 LED Indications

The front panel LEDs indicates instant status of port links, data activity, system operation, PoE in use status and system power, helps monitor and troubleshoot when needed.

SGSD-1022 LED indication

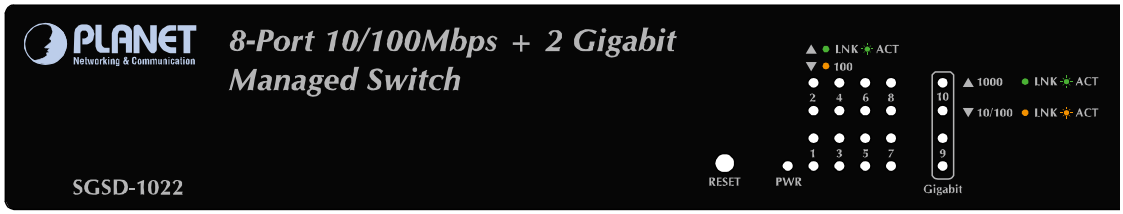


Figure 2-5 SGSD-1022 LED panel

■ **System**

LED	Color	Function
PWR	**Green**	**Lights** to indicate that the Switch is powered on. **Blink** to indicate the System is running under booting procedure.

■ **10/100Base-TX interfaces (Port-1 to Por-8)**

LED	Color	Function
LNK/ACT	**Green**	**Lights**: To indicate the link through that port is successfully established. **Blink:** To indicate that the switch is actively sending or receiving data over that port.
100	**Orange**	**Lights**: indicate that the port is operating at **100Mbps**. **Off:** If LNK/ACT LED light-> indicate that the port is operating at **10Mbps** If LNK/ACT LED Off -> indicate that the port is link down

■ **10/100/1000Base-T interfaces (Port-9 and Port-10) and SFP interfaces**

LED	Color	Function
1000 LNK/ACT	**Green**	**Lights:** To indicate the link through that port is successfully established with speed **1000Mbps**
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If L10/100 NK/ACT LED light-> indicate that the port is operating at 10Mbps or 100Mbps If LNK/ACT LED Off -> indicate that the port is link down
10/100 LNK/ACT	**Orange**	**Lights:** To indicate the link through that port is successfully established with speed 10Mbps or 100Mbps
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If 1000 LNK/ACT LED light-> indicate that the port is operating at 1000Mbps If 1000 LNK/ACT LED Off -> indicate that the port is link down

SGSD-1022P LED indication

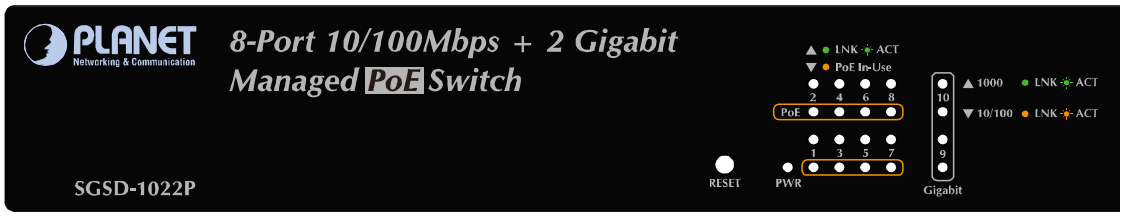


Figure 2-6 SGSD-1022P LED panel

■ **System**

LED	Color	Function
PWR	**Green**	**Lights** to indicate that the Switch is powered on. **Blink** to indicate the System is running under booting procedure.

■ **10/100Base-TX , PoE interfaces (Port-1 to Por-8)**

LED	Color	Function
LNK/ACT	**Green**	**Lights**: To indicate the link through that port is successfully established. **Blink:** To indicate that the switch is actively sending or receiving data over that port.
PoE In-Use	**Orange**	**Lights**: To indicate the port is providing 48VDC in-line power **Off:** To indicate the connected device is not a PoE Powered Device (PD)

■ **10/100/1000Base-T interfaces (Port-9 and Port-10) and SFP interfaces**

LED	Color	Function
1000 LNK/ACT	**Green**	**Lights:** To indicate the link through that port is successfully established with speed **1000Mbps**
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If L10/100 NK/ACT LED light-> indicate that the port is operating at 10Mbps or 100Mbps If LNK/ACT LED Off -> indicate that the port is link down
10/100 LNK/ACT	**Orange**	**Lights:** To indicate the link through that port is successfully established with speed 10Mbps or 100Mbps
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If 1000 LNK/ACT LED light-> indicate that the port is operating at 1000Mbps If 1000 LNK/ACT LED Off -> indicate that the port is link down

SGSW-2840 / SGSW-2840R LED indication

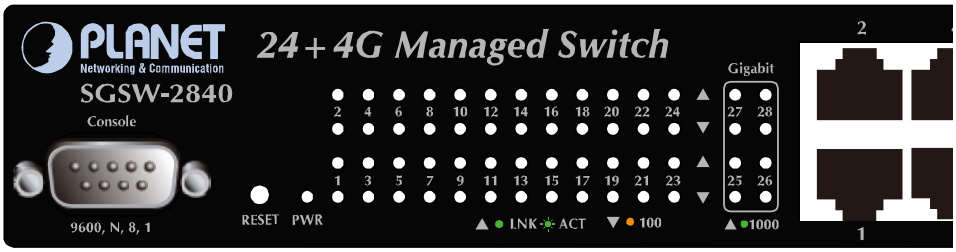


Figure 2-7 SGSW-2840 LED panel

■ **System**

LED	Color	Function
PWR	**Green**	**Lights** to indicate that the Switch is powered on. **Blink** to indicate the System is running under booting procedure.

■ **10/100Base-TX interfaces (Port-1 to Por-24)**

LED	Color	Function
LNK/ACT	**Green**	**Lights**: To indicate the link through that port is successfully established. **Blink:** To indicate that the switch is actively sending or receiving data over that port.
100	**Orange**	**Lights**: indicate that the port is operating at **100Mbps**. **Off:** If LNK/ACT LED light-> indicate that the port is operating at **10Mbps** If LNK/ACT LED Off -> indicate that the port is link down

■ **10/100/1000Base-T interfaces (Port-25 to Port-28) and SFP interfaces**

LED	Color	Function
1000 LNK/ACT	**Green**	**Lights:** To indicate the link through that port is successfully established with speed **1000Mbps**
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If L10/100 NK/ACT LED light-> indicate that the port is operating at 10Mbps or 100Mbps If LNK/ACT LED Off -> indicate that the port is link down
10/100 LNK/ACT	**Orange**	**Lights:** To indicate the link through that port is successfully established with speed 10Mbps or 100Mbps
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If 1000 LNK/ACT LED light-> indicate that the port is operating at 1000Mbps If 1000 LNK/ACT LED Off -> indicate that the port is link down

SGSW-2840P LED indication

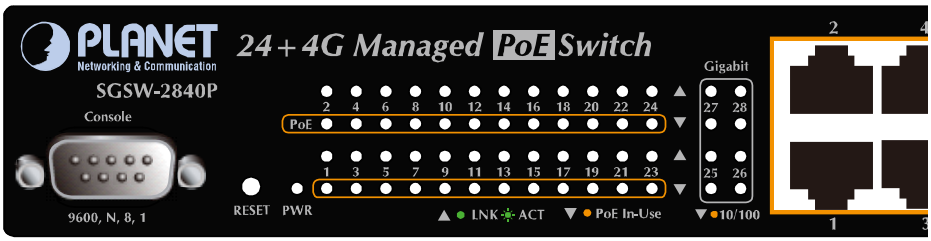


Figure 2-8 SGSW-2840P LED panel

■ **System**

LED	Color	Function
PWR	**Green**	**Lights** to indicate that the Switch is powered on. **Blink** to indicate the System is running under booting procedure.
PWR Alert	**Green**	**Lights** to indicate that the power supply failure
FAN1 Alert	**Green**	**Lights** to indicate that the FAN1 failure
FAN2 Alert	**Green**	**Lights** to indicate that the FAN2 failure

■ **10/100Base-TX, PoE interfaces (Port-1 to Por-24)**

LED	Color	Function
LNK/ACT	**Green**	**Lights**: To indicate the link through that port is successfully established. **Blink:** To indicate that the switch is actively sending or receiving data over that port.
PoE In-Use	**Orange**	**Lights**: To indicate the port is providing 48VDC in-line power **Off:** To indicate the connected device is not a PoE Powered Device (PD)

■ **10/100/1000Base-T interfaces (Port-25 to Port-28) and SFP interfaces**

LED	Color	Function
1000 LNK/ACT	**Green**	**Lights:** To indicate the link through that port is successfully established with speed **1000Mbps**
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If L10/100 NK/ACT LED light-> indicate that the port is operating at 10Mbps or 100Mbps If LNK/ACT LED Off -> indicate that the port is link down
10/100 LNK/ACT	**Orange**	**Lights:** To indicate the link through that port is successfully established with speed 10Mbps or 100Mbps
		Blink: To indicate that the switch is actively sending or receiving data over that port.
		Off: If 1000 LNK/ACT LED light-> indicate that the port is operating at 1000Mbps If 1000 LNK/ACT LED Off -> indicate that the port is link down

2.1.3 Switch Rear Panel

The rear panel of the Managed Switch indicates an AC inlet power socket, which accept input power from 100 to 240V AC, 50-60Hz. Figure 2-9 to Figure 2-13 shows the rear panel of these Managed Switches

SGSD-1022 Rear Panel

Figure 2-9 Rear panel of SGSD-1022

SGSD-1022P Rear Panel

Figure 2-10 Rear panel of SGSD-1022P

SGSW-2840 Rear Panel

Figure 2-11 Rear panel of SGSW-2840

SGSW-2840R Rear Panel

Figure 2-12 Rear panel of SGSW-2840R

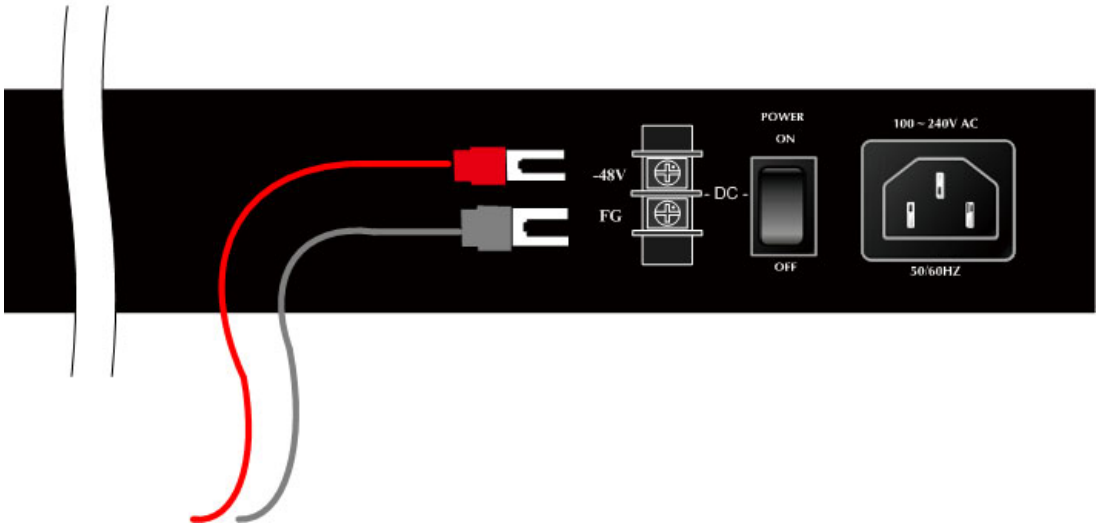


Figure 2-13 Rear panel of SGSW-2840

SGSW-2840P Rear Panel

Figure 2-14 Rear panel of SGSW-2840P

■ **Power Receptacle**

For compatibility with electric service in most areas of the world, the WGS3-Layer 3 Switch's power supply automatically adjusts to line power in the range 100-240VAC and 50/60 Hz.

Plug the female end of the power cord firmly into the receptalbe on the rear panel of the Switch. Plug the other end of the

power cord into an electric service outlet then the power will be ready.

Power Notice:

The device is a power-required device, it means, it will not work till it is powered. If your networks should active all the time, please consider using UPS (Uninterrupted Power Supply) for your device. It will prevent you from network data loss or network downtime.

In some area, installing a surge suppression device may also help to protect your Managed Switch from being damaged by unregulated surge or current to the Switch or the power adapter.

2.2 Install the Switch

This section describes how to install your Managed Switch and make connections to the Managed Switch. Please read the following topics and perform the procedures in the order being presented. To install your Managed Switch on a desktop or shelf, simply complete the following steps.

2.2.1 Desktop Installation

To install the Managed Switch on desktop or shelf, please follows these steps:

Step1: Attach the rubber feet to the recessed areas on the bottom of the Managed Switch.

Step2: Place the Managed Switch on the desktop or the shelf near an AC power source, as shown in Figure 2-4.

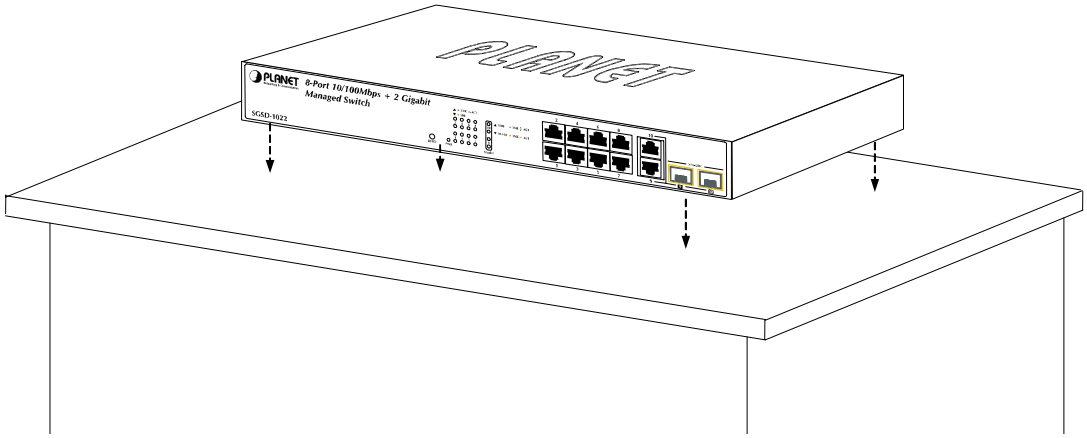


Figure 2-15 Place the Switch on the desktop

Step3: Keep enough ventilation space between the Managed Switch and the surrounding objects.

Note

When choosing a location, please keep in mind the environmental restrictions discussed in Chapter 1, Section 4, and Specification.

Step4: Connect the Managed Switch to network devices.

Connect one end of a standard network cable to the 10/100/1000 RJ-45 ports on the front of the Managed Switch

Connect the other end of the cable to the network devices such as printer servers, workstations or routers…etc.

Note

Connection to the Managed Switch requires UTP Category 5 network cabling with RJ-45 tips. For more information, please see the Cabling Specification in Appendix A.

Step5: Supply power to the Managed Switch.

Connect one end of the power cable to the Managed Switch.

Connect the power plug of the power cable to a standard wall outlet.

When the Managed Switch receives power, the Power LED should remain solid Green.

2.2.2 Rack Mounting

To install the Managed Switch in a 19-inch standard rack, please follows the instructions described below.

Step1: Place the Managed Switch on a hard flat surface, with the front panel positioned towards the front side.

Step2: Attach the rack-mount bracket to each side of the Managed Switch with supplied screws attached to the package. Figure 2-16 and 2-17 shows how to attach brackets to one side of the Managed Switch.

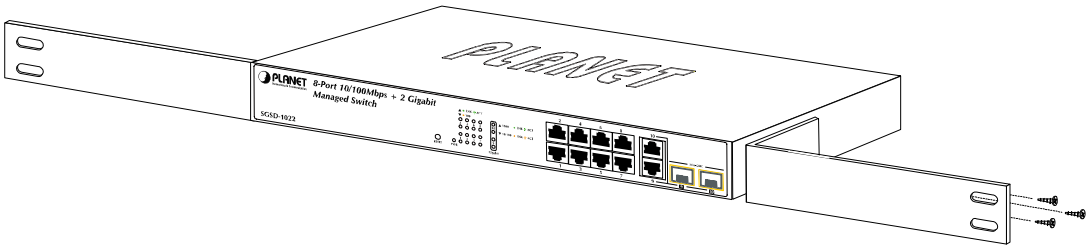


Figure 2-16 Attach brackets to the Managed Switch.

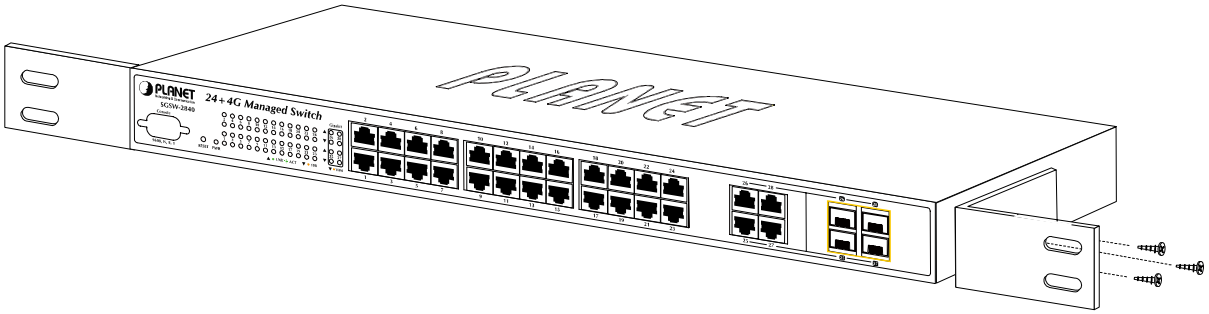


Figure 2-17 Attach brackets to the Managed Switch.

You must use the screws supplied with the mounting brackets. Damage caused to the parts by using incorrect screws would invalidate the warranty.

Step3: Secure the brackets tightly.

Step4: Follow the same steps to attach the second bracket to the opposite side.

Step5: After the brackets are attached to the Managed Switch, use suitable screws to securely attach the brackets to the rack, as shown in Figure 2-17 and 2-18.

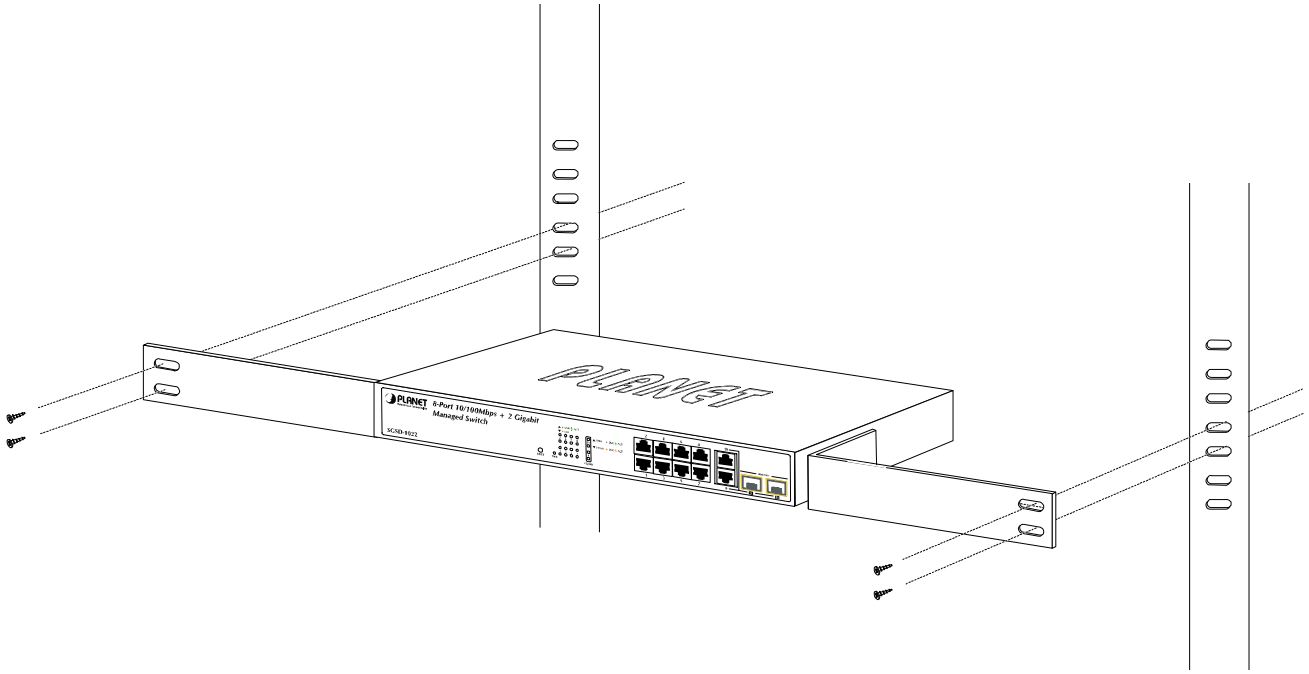


Figure 2-18 Mounting SGSD-1022 in a Rack

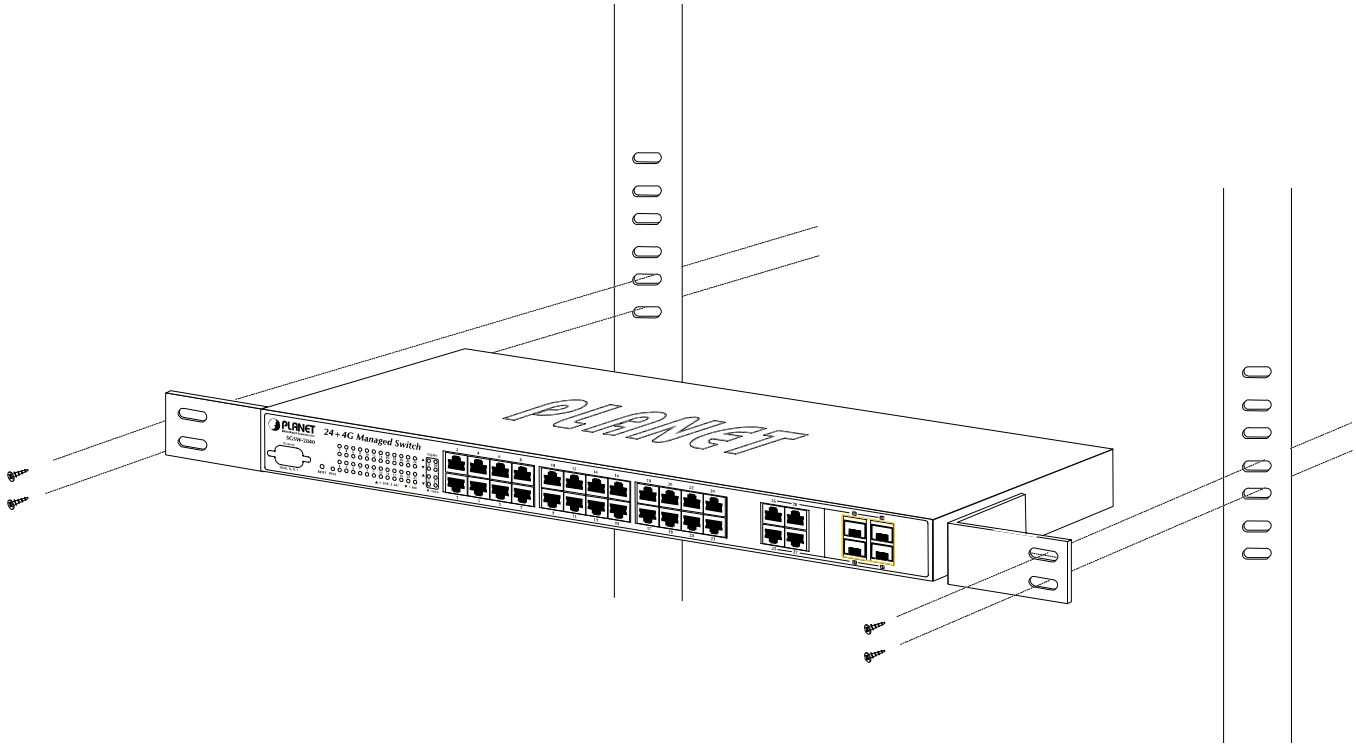


Figure 2-19 Mounting SGSW-2840 in a Rack

Step6: Proceeds with the steps 4 and steps 5 of session 2.2.1 Desktop Installation to connect the network cabling and supply power to the Managed Switch.

2.2.3 Installing the SFP transceiver

The sections describe how to insert an SFP transceiver into an SFP slot.

The SFP transceivers are hot-pluggable and hot-swappable. You can plug-in and out the transceiver to/from any SFP port without having to power down the Managed Switch. As the Figure 2-19 appears.

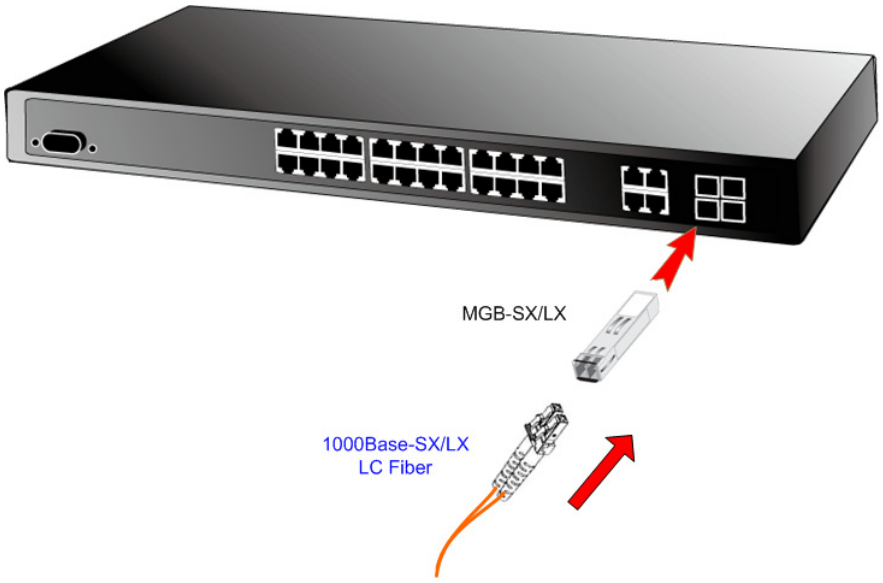


Figure 2-20 Plug-in the SFP transceiver

Approved PLANET SFP Transceivers

PLANET Managed Switch supports both Single mode and Multi-mode SFP transceiver. The following list of approved PLANET SFP transceivers is correct at the time of publication:

■MGB-SX SFP (1000BASE-SX SFP transceiver)

■MGB-LX SFP (1000BASE-LX SFP transceiver)

Note

It recommends using PLANET SFPs on the Managed Switch. If you insert a SFP transceiver that is not supported, the Managed Switch will not recognize it.

Before connect the other Managed Switches, workstation or Media Converter.

1. Make sure both side of the SFP transceiver are with the same media type, for example: 1000Base-SX to 1000Base-SX, 1000Bas-LX to 1000Base-LX.
2. Check the fiber-optic cable type match the SFP transceiver model.
   - To connect to 1000Base-SX SFP transceiver, use the Multi-mode fiber cable- with one side must be male duplex LC connector type.
   - To connect to 1000Base-LX SFP transceiver, use the Single-mode fiber cable-with one side must be male duplex LC connector type.

Connect the fiber cable

1. Attach the duplex LC connector on the network cable into the SFP transceiver.
2. Connect the other end of the cable to a device – switches with SFP installed, fiber NIC on a workstation or a Media Converter..
3. Check the LNK/ACT LED of the SFP slot on the front of the Managed Switch. Ensure that the SFP transceiver is operating correctly.
4. Check the Link mode of the SFP port if the link failed. Co works with some fiber-NICs or Media Converters, set the Link mode to "1000 Force" is needed.

Remove the transceiver module

1. Make sure there is no network activity by consult or check with the network administrator. Or through the management interface of the switch/converter (if available) to disable the port in advance.
2. Remove the Fiber Optic Cable gently.
3. Turn the handle of the MGB module to horizontal.
4. Pull out the module gently through the handle.

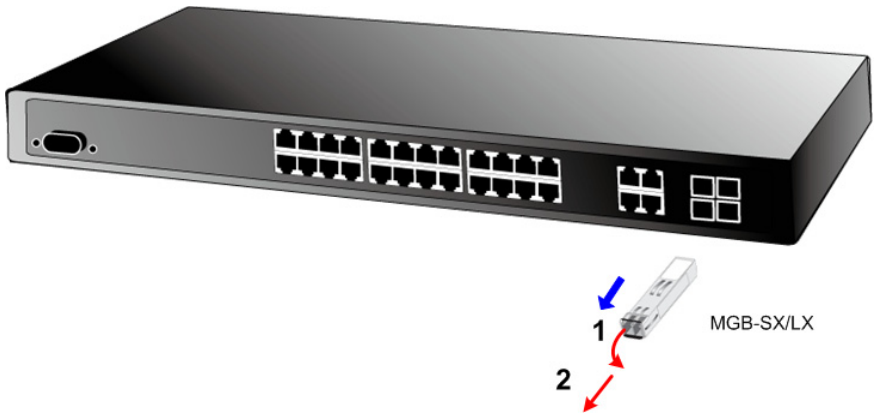


Figure 2-21 Pull out the SFP transceiver

Note	Never pull out the module without pull the handle or the push bolts on the module. Direct pull out the module with violent could damage the module and SFP module slot of the Managed Switch.

3. SWITCH MANAGEMENT

This chapter explains the methods that you can use to configure management access to the Managed Switch. It describes the types of management applications and the communication and management protocols that deliver data between your management device (work-station or personal computer) and the system. It also contains information about port connection options.

This chapter covers the following topics:

- Requirements
- Management Access Overview
- Administration Console Access
- Web Management Access
- SNMP Access
- Standards, Protocols, and Related Reading

3.1 Requirements

- **Workstations** of subscribers running Windows 98/ME, NT4.0, 2000/XP, MAC OS9 or later, Linux, UNIX or other platform compatible with **TCP/IP** protocols.
- **Workstation** installed with **Ethernet NIC** (Network Interface Card)
- **Serial Port** connect (Terminal)
  - Above PC with COM Port (DB-9 / RS-232) or USB-to-RS-232 converter
- Ethernet Port connect
  - Network cables - Use standard network (UTP) cables with RJ45 connectors.
- Above Workstation installed with **WEB Browser** and J**AVA runtime environment** Plug-in

It is recommended to use Internet Explore 6.0 or above to access Managed Switch.

3.2 Management Access Overview

The Managed Switch gives you the flexibility to access and manage it using any or all of the following methods:

- An administration **console**
- **Web browser** interface
- An external **SNMP-based network management application**

The administration console and Web browser interface support are embedded in the Managed Switch software and are available for immediate use. Each of these management methods has their own advantages. Table 3-1 compares the three management methods.

Method	Advantages	Disadvantages
Console	• No IP address or subnet needed • Text-based • Telnet functionality and HyperTerminal built into Windows 95/98/NT/2000/ME/XP operating systems • Secure	• Must be near switch or use dial-up connection • Not convenient for remote users • Modem connection may prove to be unreliable or slow
Web Browser	• Ideal for configuring the switch remotely • Compatible with all popular browsers • Can be accessed from any location • Most visually appealing	• Security can be compromised (hackers need only know the IP address and subnet mask) • May encounter lag times on poor connections
SNMP Agent	• Communicates with switch functions at the MIB level • Based on open standards	• Requires SNMP manager software • Least visually appealing of all three methods • Some settings require calculations • Security can be compromised (hackers need only know the community name)

Table 3-1 Management Methods Comparison

3.3 Administration Console

The administration console is an internal, character-oriented, and command line user interface for performing system administration such as displaying statistics or changing option settings. Using this method, you can view the administration console from a terminal, personal computer, Apple Macintosh, or workstation connected to the switch's console (serial) port. There are two ways to use this management method: via direct access or modem port access. The following sections describe these methods. For more information about using the console, refer to **Chapter 5 Command Line Interface Console Management**.

Figure 3-1 Console management

Direct Access

Direct access to the administration console is achieved by directly connecting a terminal or a PC equipped with a terminal-emulation program (such as **HyperTerminal**) to the Managed Switch console (serial) port.

When using this management method, a **straight DB9 RS-232 cable** is required to connect the switch to the PC. After making this connection, configure the terminal-emulation program to use the following parameters:

The default parameters are:

- **9600 bps**
- **8 data bits**
- **No parity**
- **1 stop bit**

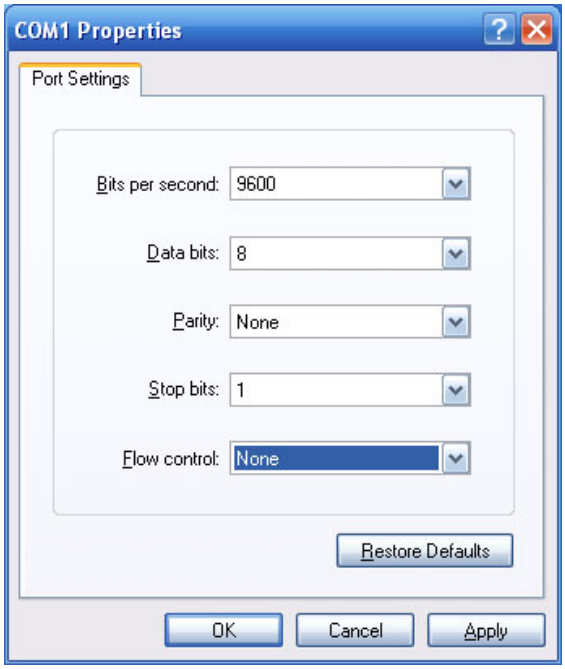


Figure 3-2 Terminal parameter settings

You can change these settings, if desired, after you log on. This management method is often preferred because you can remain connected and monitor the system during system reboots. Also, certain error messages are sent to the serial port, regardless of the interface through which the associated action was initiated. A Macintosh or PC attachment can use any terminal-emulation program for connecting to the terminal serial port. A workstation attachment under UNIX can use an emulator such as TIP.

3.4 Web Management

The Managed Switch provides a browser interface that lets you configure and manage the switch remotely. After you set up your IP address for the switch, you can access the Managed Switch's Web interface applications directly in your Web browser by entering the IP address of the Managed Switch. You can then use your Web browser to list and manage the Managed Switch configuration parameters from one central location, just as if you were directly connected to the Managed Switch's console port. Web Management requires either **Microsoft Internet Explorer 6.0** or later, **Safari** or **Mozilla Firefox 1.5** or later.

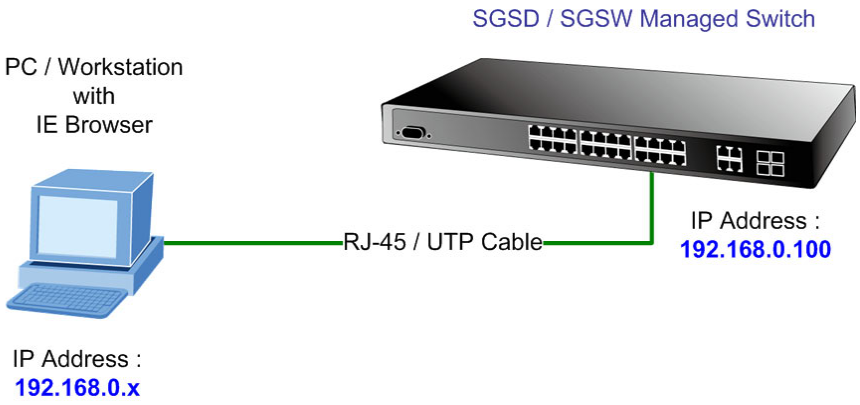


Figure 3-3 Web management

3.5 SNMP-Based Network Management

You can use an external SNMP-based application to configure and manage the Managed Switch, such as SNMPc Network Manager, HP Openview Network Node Management (NNM) or What's Up Gold. This management method requires the SNMP agent on the switch and the SNMP Network Management Station to use the **same community string**. This management method, in fact, uses two community strings: the **get community** string and the **set community** string. If the SNMP Net-work management Station only knows the set community string, it can read and write to the MIBs. However, if it only knows the get community string, it can only read MIBs. The default gets and sets community strings for the Managed Switch are public.

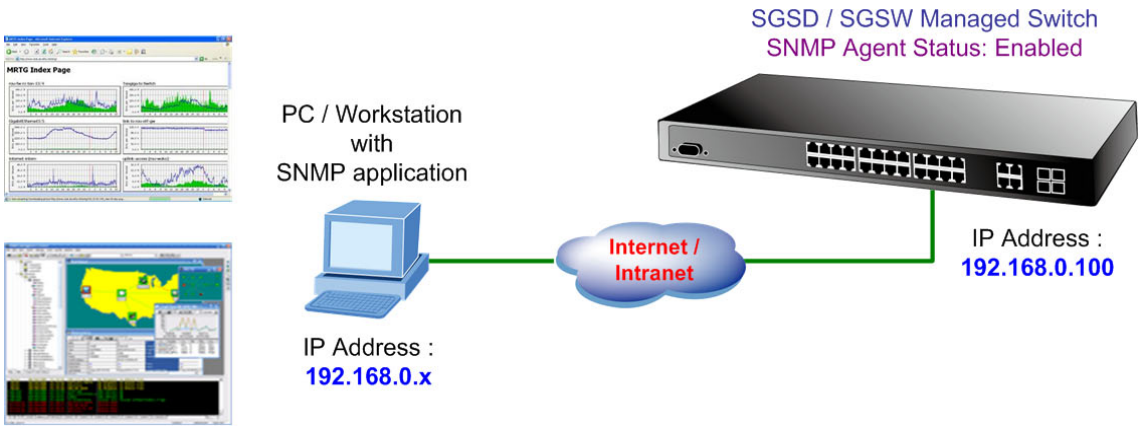


Figure 3-4 SNMP management

3.6 Protocols

The Managed Switch supports the following protocols:

- Virtual terminal protocols, such as Telnet
- Simple Network Management Protocol (SNMP)

3.6.1 Virtual Terminal Protocols

A virtual terminal protocol is a software program, such as **Telnet**, that allows you to establish a management session from a Macintosh, a PC, or a UNIX workstation. Because Telnet runs over TCP/IP, you must have at least one IP address configured on the Managed Switch before you can establish access to it with a virtual terminal protocol.

Terminal emulation differs from a virtual terminal protocol in that you must connect a terminal directly to the console (serial) port.

3.6.2 SNMP Protocol

Simple Network Management Protocol (SNMP) is the standard management protocol for multi-vendor IP networks. SNMP supports transaction-based queries that allow the protocol to format messages and to transmit information between reporting devices and data-collection programs. SNMP runs on top of the User Datagram Protocol (UDP), offering a connectionless-mode service.

3.6.3 Management Architecture

All of the management application modules use the same Messaging Application Programming Interface (MAPI). By unifying management methods with a single MAPI, configuration parameters set using one method (console port, for example) are immediately displayable by the other management methods (for example, SNMP agent of Web browser).
The management architecture of the switch adheres to the IEEE open standard. This compliance assures customers that the Managed Switch is compatible with, and will interoperate with other solutions that adhere to the same open standard.

4. WEB CONFIGURATION

This section introduces the configuration and functions of the Web-Based management.

About Web-based Management

The Managed Switch offers management features that allow users to manage the Managed Switch from anywhere on the network through a standard browser such as Microsoft Internet Explorer.

The Web-Based Management supports Internet Explorer 6.0. It is based on Java Applets with an aim to reduce network bandwidth consumption, enhance access speed and present an easy viewing screen.

By default, IE6.0 or later version does not allow Java Applets to open sockets. The user has to explicitly modify the browser setting to enable Java Applets to use network ports.

The Managed Switch can be configured through an Ethernet connection, make sure the manager PC must be set on same the IP subnet address with the Managed Switch.

For example, the default IP address of the SGSD / SGSW Managed Switch is ***192.168.0.100***, then the manager PC should be set at **192.168.0.x** (where x is a number between 1 and 254, except 100), and the default subnet mask is 255.255.255.0.

If you have changed the default IP address of the Managed Switch to 192.168.1.1 with subnet mask 255.255.255.0 via console, then the manager PC should be set at 192.168.1.x (where x is a number between 2 and 254) to do the relative configuration on manager PC.

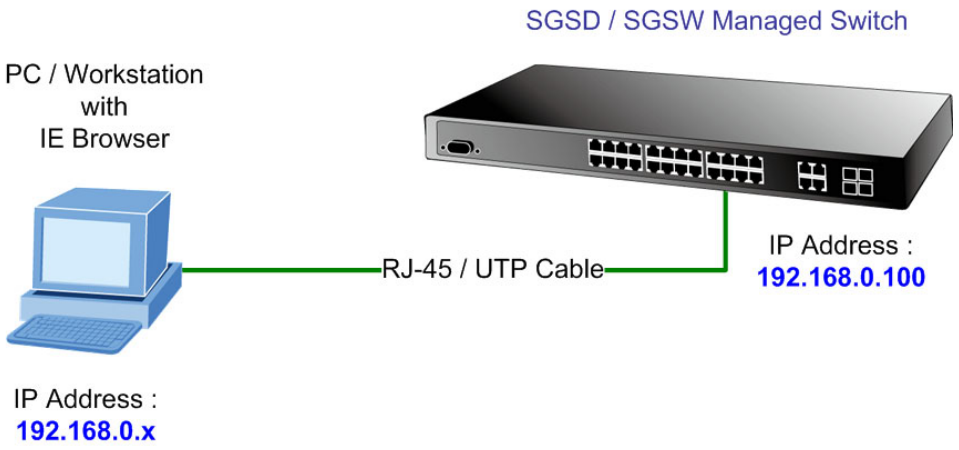


Figure 4-1-1 Web Management

■ **Logging on the switch**

1. Use Internet Explorer 6.0 or above Web browser. Enter the factory-default IP address to access the Web interface. The factory-default IP Address as following:

http://192.168.0.100

2. When the following login screen appears, please enter the default username **"admin"** with password "**admin**" (or the username/password you have changed via console) to login the main screen of Managed Switch. The login screen in Figure 4-1-2 appears.

Connect to 192.168.0.100
The server 192.168.0.100 at Web Management requires a username and password.
Warning: This server is requesting that your username and password be sent in an insecure manner (basic authentication without a secure connection).
User name:
admin
Password:
Remember my password
OK
Cancel

Figure 4-1-2 Login screen

Default User name: **admin**

Default Password: **admin**

After entering the username and password, the main screen appears as Figure 4-1-3.

Figure 4-1-3 Default main page

Now, you can use the Web management interface to continue the switch management or manage the Managed Switch by Web interface. The Switch Menu on the left of the web page let you access all the commands and statistics the Managed Switch provides.

Note

1. It is recommended to use Internet Explore 6.0 or above to access Managed Switch.
2. The changed IP address take effect immediately after click on the Apply button, you need to use the new IP address to access the Web interface.
3. The changed IP address remains the original after reboot the switch unless the configuration is saved. To save the changed IP address, please move to **System \ File Management \ Copy** menu and select "**running-config to startup-config**".

4.1 Main WEB PAGE

The SGSD / SGSW Managed Switch provides a Web-based browser interface for configuring and managing it. This interface allows you to access the Managed Switch using the Web browser of your choice. This chapter describes how to use the Managed Switch's Web browser interface to configure and manage it.

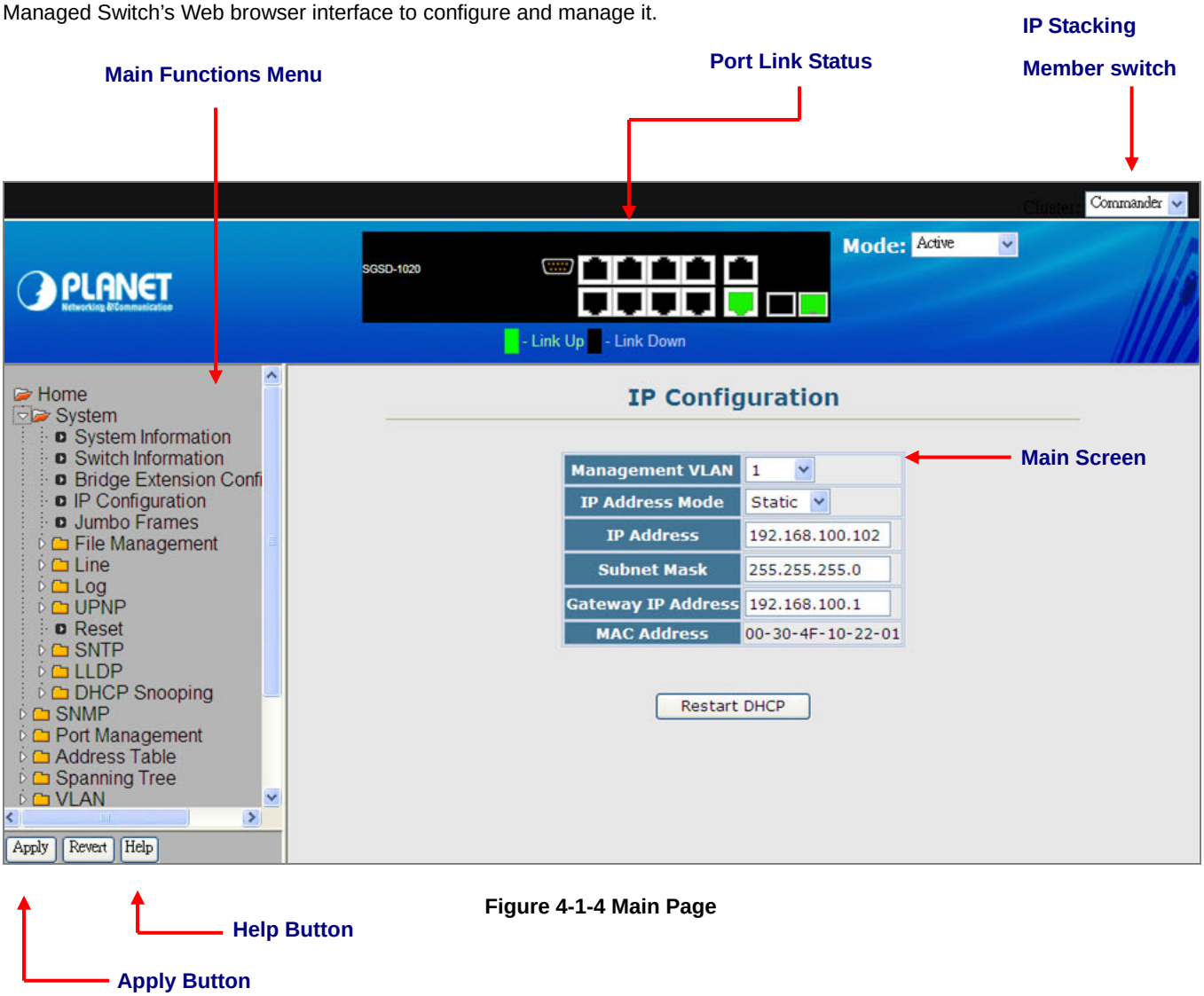


Figure 4-1-4 Main Page

Note

1. To ensure proper screen refresh, be sure that Internet Explorer is configured so that the setting "Check for newer versions of stored pages" reads "**Every visit to the page**".
   - Internet Explorer 6.x and earlier: This option is available under the menu "Tools / Internet Options / General / Temporary Internet Files / Settings".
   - Internet Explorer 7.x: This option is available under "Tools / Internet Options / General / Browsing History / Settings / Temporary Internet Files".
2. You may have to manually refresh the screen after making configuration changes by pressing the browser's

Panel Display

The web agent displays an image of the Managed Switch's ports. The Mode can be set to display different information for the ports, including Active (i.e., up or down), Duplex (i.e., half or full duplex, or Flow Control (i.e., with or without flow control). Clicking on the image of a port opens the Port Configuration page.

Main Menu

Using the onboard web agent, you can define system parameters, manage and control the Managed Switch, and all its ports, or monitor network conditions. The following table briefly describes the selections available from this program.

Via the Web-Management, the administrator can setup the Managed Switch by select the functions those listed in the Main Function. The screen in Figure 4-1-5 appears.

Figure 4-1-5 SGSD/SGSW Managed Switch Main Funcrions Menu

Configuration Options

Configurable parameters have a dialog box or a drop-down list. Once a configuration change has been made on a page, be sure to click on the Apply button to confirm the new setting. The following table summarizes the web page configuration buttons.

Button	Action
Apply	Sets specified values to the system.
Revert	Cancels specified values and restores current values prior to pressing Apply.
Help	Links directly to webhelp.

The following Main functions can be configured here:

- **System**
- **SNMP**
- **Port Management**
- **Address Table**
- **Spanning Tree**
- **VLAN**
- **Multicast**
- **QoS**
- **Security**
- **Cluster**

4.2 System

Use the System menu items to display and configure basic administrative details of the Managed Switch. Under System the following topics are provided to configure and view the system information: This section has the following items:

■ **System Information**	Provides basic system description, including contact information	
■ **Switch Information**	Shows the number of ports, and hardware/firmware version numbers	
■ **Bridge Extension Configuration**	Shows the bridge extension parameters	
■ **IP Configuration**	Sets the IP address for management access	
■ **Jumbo Frames**	Enables jumbo frame packets.	
■ **File Management**	**Copy Operation**	Allows the transfer and copying files
	Delete	Allows deletion of files from the flash memory
	Set Start-Up	Sets the startup file
■ **Line**	Sets console port and telnet connection parameters	
■ **Log**	**Logs**	Stores and displays error messages
	System Logs	Sends error messages to a logging process
	Remote Logs	Configures the logging of messages to a remote logging process
	SMTP	Sends an SMTP client message to a participating server.
■ **Reset**	Restarts the switch	
■ **SNTP**	Simple Network Time Protocol. Configures SNTP client settings, including broadcast mode or aspecified list of servers	
■ **LLDP**	Link Layer Discovery Protocol	

4.2.1 System Information

Use the **System Information** screen to display descriptive information about the Managed Switch, or for quick system identification. You can easily identify the system by displaying the device name, location and contact information. The System Information screen in Figure 4-2-1 appears.

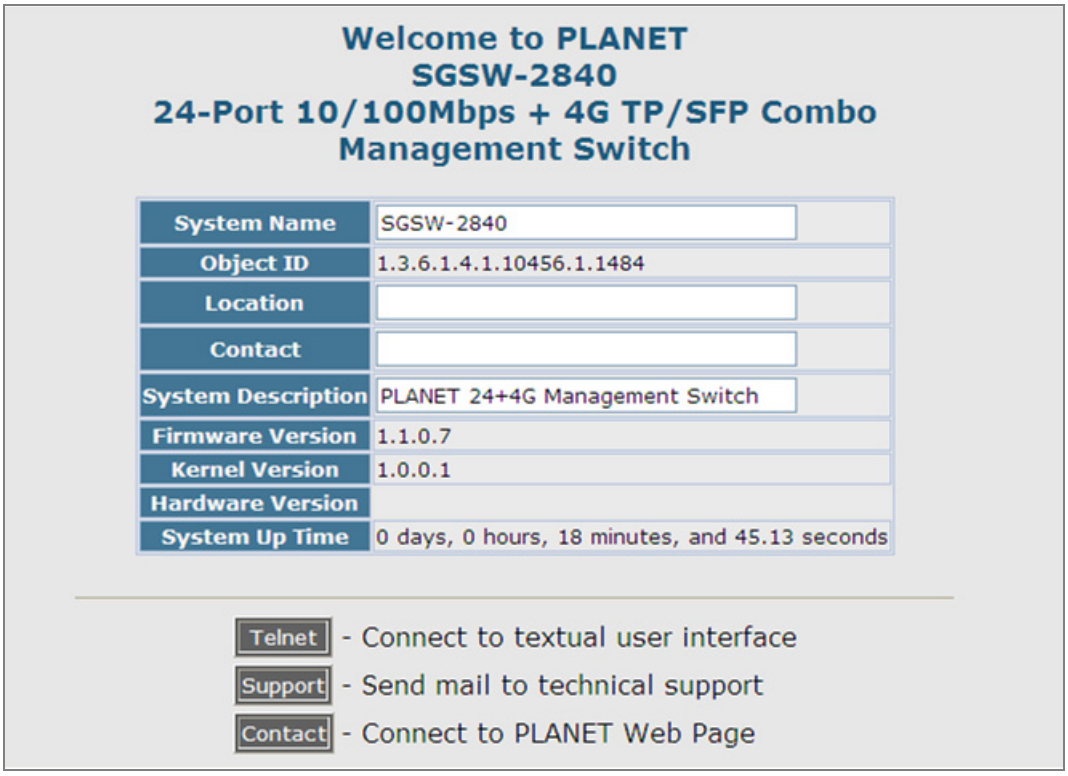


Figure 4-2-1 System Information screenshot

The page includes the following fields:

Object	Description
• **System Name -**	Enter the name you want to use to identify this switch. You may use up to 31 alpha-numeric characters. The factory default is blank.
• **Object ID -**	The base object ID for the Managed Switch's enterprise MIB.
• **Location -**	Enter the location of this Managed Switch. You may use up to 31 alpha-numeric characters. The factory default is blank.
• **Contact -**	Enter the contact person for this switch. You may use up to 31 alpha-numeric characters. The factory default is blank.
• **System Up time -**	The time in days, hours and minutes since the last switch reboot.

This page also includes a **Telnet** button that allows access to the Command Line Interface via Telnet.

4.2.2 Switch Information

Use the **Switch Information** page to display hardware/firmware version numbers for the main board and management software, as well as the number of ports of the system. The Switch Information screen in Figure 4-2-2 appears.

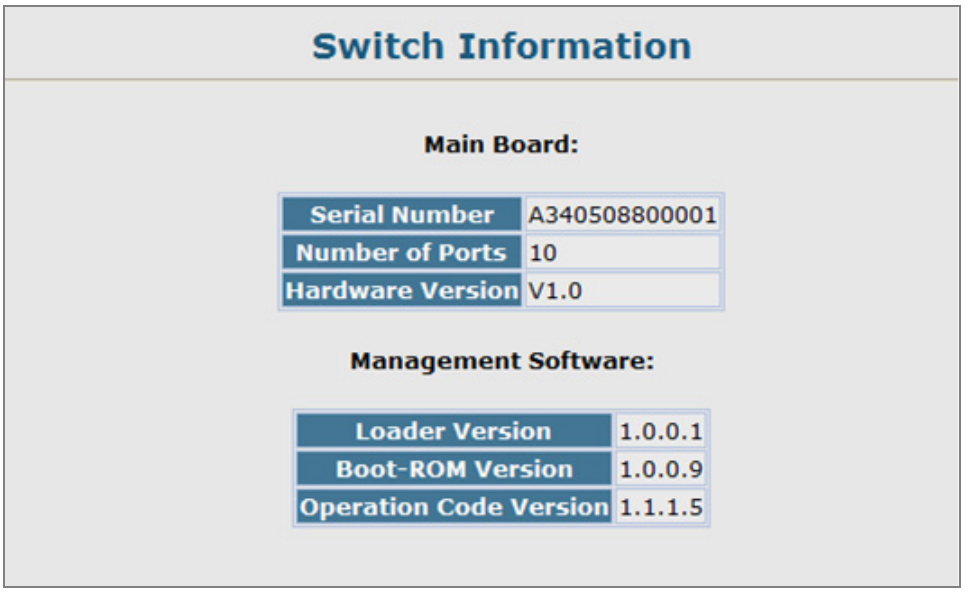


Figure 4-2-2 Switch Information screenshot

The page includes the following fields:

■ **Main Board**

Object	Description
• **Serial Number**	The serial number of the Managed Switch.
• **Number of Ports**	Number of built-in RJ-45 ports. The default value of each model as below: SGSD-1022 / SGSD-1022P: 10 SGSW-2840 / SGSW-2840P : 28
• **Hardware Version**	Hardware version of the main board.

■ **Management Software**

Object	Description
• **Loader Version**	Version number of loader code.
• **Boot-ROM Version**	Version of Power-On Self-Test (POST) and boot code.
• **Operation Code Version**	Version number of runtime code.

4.2.3 Bridge Extension Configuration

The Bridge MIB includes extensions for managed devices that support **Multicast Filtering**, **Traffic Classes**, and **Virtual LANs**. You can access these extensions to display default settings for the key variables, or to configure the global setting for **GARP VLAN Registration Protocol (GVRP).**

The Bridge Extension Configuration screen in Figure 4-2-3 appears.

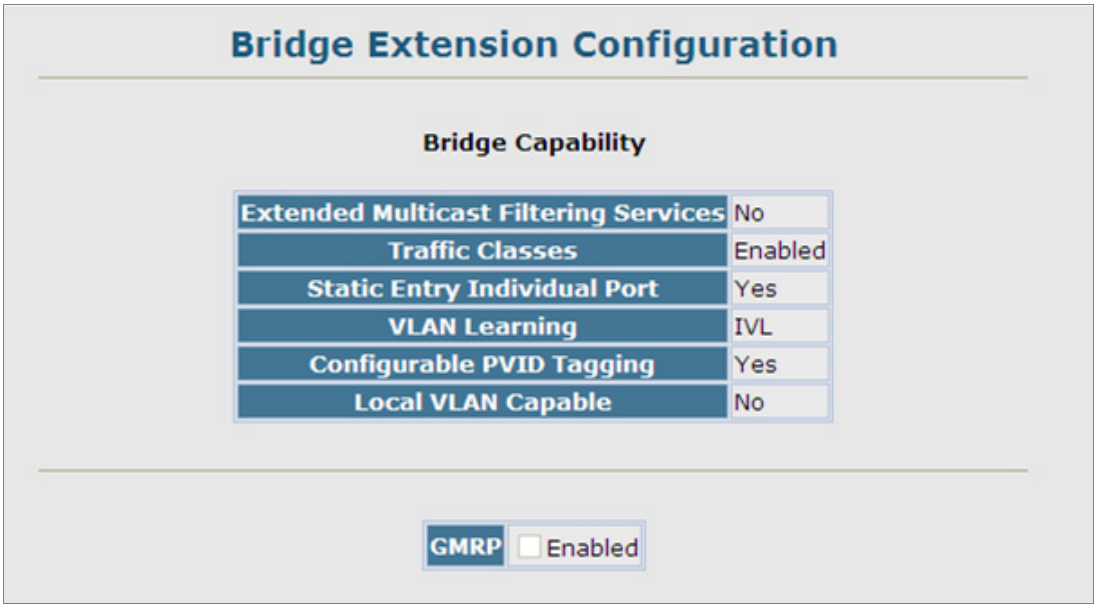


Figure 4-2-3 Bridge Extension Configuration screenshot

The page includes the following fields:

Object	Description
• **Extended Multicast Filtering Services**	This Managed Switch does not support the filtering of individual multicast addresses based on **GMRP (GARP Multicast Registration Protocol)**.
• **Traffic Classes**	This Managed Switch provides mapping of user priorities to multiple traffic classes. (Refer to "**Class of Service Configuration**")
• **VLAN Learning**	This Managed Switch uses **Independent VLAN Learning (IVL)**, where each port maintains its own filtering database.
• **Configurable PVID Tagging**	This Managed Switch allows you to override the default **Port VLAN ID (PVID** used in frame tags) and egress status (VLAN-Tagged or Untagged) on each port. (Refer to "**VLAN Configuration**".)
• **Local VLAN Capable**	This Managed Switch does not support multiple local bridges outside of the scope of 802.1Q defined VLANs.
• **GMRP**	**GARP Multicast Registration Protocol (GMRP)** allows network devices to register endstations with multicast groups. This Managed Switch **does not** support GMRP; it uses the Internet Group Management Protocol (IGMP) to provide automatic multicast filtering.

4.2.4 IP Configuration

This section describes how to configure an IP interface for management access over the network. The IP address for the stack is obtained via DHCP by default. To manually configure an address, you need to change the Managed Switch's default settings to values that are compatible with your network. You may also need to an establish a default gateway between the stack and management stations that exist on another network segment.

You can manually configure a specific IP address, or direct the device to obtain an address from a BOOTP or DHCP server. Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods.

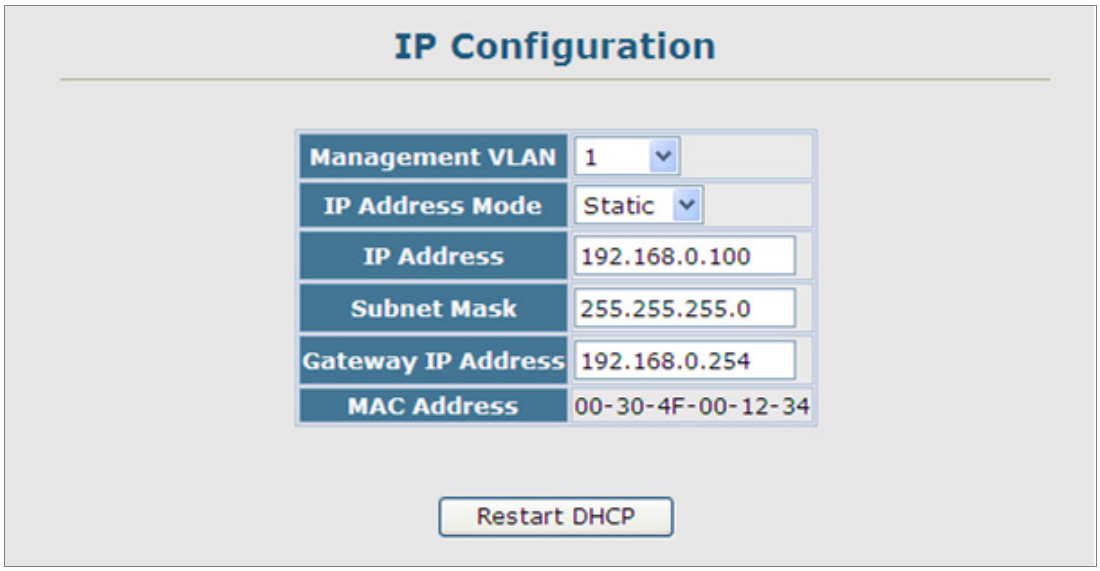


Figure 4-2-4 IP Configuration screenshot

Object	Description
• **Management VLAN**	ID of the configured VLAN (1-4094). This is the only VLAN through which you can manage the Managed Switch. By default, all ports on the Managed Switch are members of VLAN 1. However, the management station can be attached to a port belonging to any VLAN, as long as that VLAN has been assigned an IP address.
• **IP Address Mode**	Specifies whether IP functionality is enabled via : ■ **Static** - manual configuration ■ **DHCP** - Dynamic Host Configuration Protocol ■ **BOOTP** - Boot Protocol If DHCP/BOOTP is enabled, IP will not function until a reply has been received from the server. Requests will be broadcast periodically by the switch for an IP address. (DHCP/BOOTP values can include the IP address, subnet mask, and default gateway.)
• **IP Address**	Address of the VLAN interface that is allowed management access. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. (Default: **192.168.0.100**)

• **Subnet Mask**	This mask identifies the host address bits used for routing to specific subnets. (Default: **255.255.255.0**)
• **Gateway IP address**	IP address of the gateway router between this device and management stations that exist on other network segments. (Default: **0.0.0.0**)
• **MAC Address**	The physical layer address for this Managed Switch.
• **Restart DHCP**	Requests a new IP address from the DHCP server.

If you lose your management connection, use a console connection and enter "**show ip interface**" to determine the new switch address.

■ **Manual Configuration**

1. Click System, **IP Configuration**.
2. Select the VLAN through which the management station is attached, set the IP Address Mode to "**Static**," enter the IP address, subnet mask and gateway, then click **Apply**.

■ **Using DHCP/BOOTP**

If your network provides DHCP/BOOTP services, you can configure the Managed Switch to be dynamically configured by these services.

1. Click System, **IP Configuration**.
2. Specify the VLAN to which the management station is attached, set the IP Address Mode to **DHCP** or **BOOTP**.
3. Click Apply to save your changes.
4. Then click **Restart DHCP** to immediately request a new address.

The Managed Switch will also broadcast a request for IP configuration settings on each power reset.

■ **Renewing DCHP**

DHCP may lease addresses to clients indefinitely or for a specific period of time. If the address expires or the switch is moved to another network segment, you will lose management access to the switch. In this case, you can reboot the switch or submit a client request to restart DHCP service via the CLI.

1. If the address assigned by DHCP is no longer functioning, you will not be able to renew the IP settings via the web interface.
2. You can only restart DHCP service via the Web interface if the current address is still available.

4.2.5 Jumbo Frames

The Managed Switch provides more efficient throughput for large sequential data transfers by supporting jumbo frames up to **9216 bytes**. Compared to standard Ethernet frames that run only up to 1.5 KB, using jumbo frames significantly reduces the per-packet overhead required to process protocol encapsulation fields.

The Jumbo Frames configure screen in Figure 4-2-5 appears.

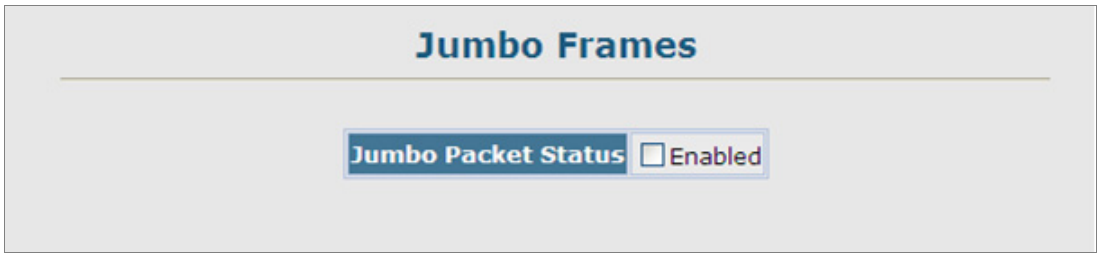


Figure 4-2-5 Jumbo Frames configure screenshot

Object	Description
• **Jumbo Packet Status**	Configures support for jumbo frames. (Default: **Disabled**)

4.2.6 File Management

The system file folder contains firmware and configuration settings. This section has the following options:

- **Copy Operation** Allows the transfer and copying files, such as:
  - Downloading System Software from a Server
  - Downloading Configuration Settings from a Server
  - Saving Configuration Settings
  - Restoring Configuration Settings
- **Delete** Allows deletion of files from the flash memory
- **Set Start-Up** Sets the startup file

4.2.6.1 Copy Operation

You can upload/download **firmware** or **configuration** to or from a TFTP server. By saving runtime code to a file on a TFTP server, that file can later be downloaded to the Managed Switch to restore operation.

You can also set the Managed Switch to use new firmware without overwriting the previous version. You must specify the method of file transfer, along with the file type and file names as required.

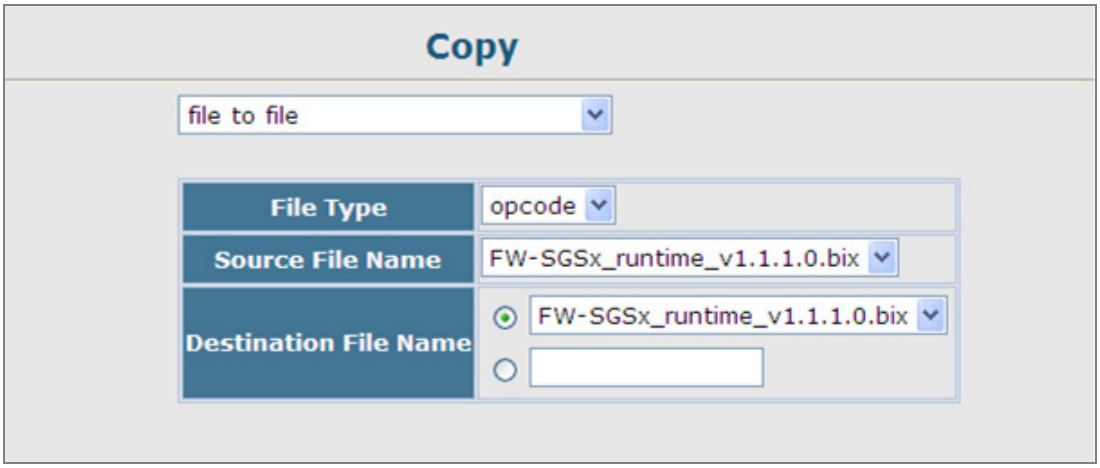


Figure 4-2-6 default Copy Operation screenshot

The page includes the following fields:

Object	Description
• **File Transfer Method**	The configuration copy operation includes these options: -**file to file** – Copies a file within the switch directory, assigning it a new name. -**file to running-config** – Copies a file in the switch to the running configuration. -**file to startup-config** – Copies a file in the switch to the startup configuration. -**file to tftp** – Copies a file from the switch to a TFTP server. -**running-config to file** – Copies the running configuration to a file. -**running-config to startup-config** – Copies the running config to the startup config. -**running-config to tftp** – Copies the running configuration to a TFTP server. -**startup-config to file** – Copies the startup configuration to a file on the switch. -**startup-config to running-config** – Copies the startup config to the running config. -**startup-config to tftp** – Copies the startup configuration to a TFTP server. -**tftp to file** – Copies a file from a TFTP server to the switch. -**tftp to running-config** – Copies a file from a TFTP server to the running config. -**tftp to startup-config** – Copies a file from a TFTP server to the startup config.
• **TFTP Server IP Address**	The IP address of a TFTP server.
• **File Type**	Specify config (configuration) to copy configuration settings.
• **File Name**	File names should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

■ Example 1: Save Current Configuration setting

To save all applied changes and set the current configuration as startup configuration. The startup-configuration file will be load automatically across a system reboot.

1. Click System, File Management, **Copy Operation**.
2. Select "**running-config to startup-config**" as the file transfer method.
3. Select the startup file name used for startup on the Managed Switch to overwrite or specify a new file name, then click **Apply**.

Figure 4-2-7 Configuration saving screenshot

Note

You can also select any configuration file as the start-up configuration by using the System/File Management /Set Start-Up page.

4. If you specify a new file name to startup-config, click System \ File Management \ **Set Start-up** to check the specified file be set to "Y" in the "Startup" column.

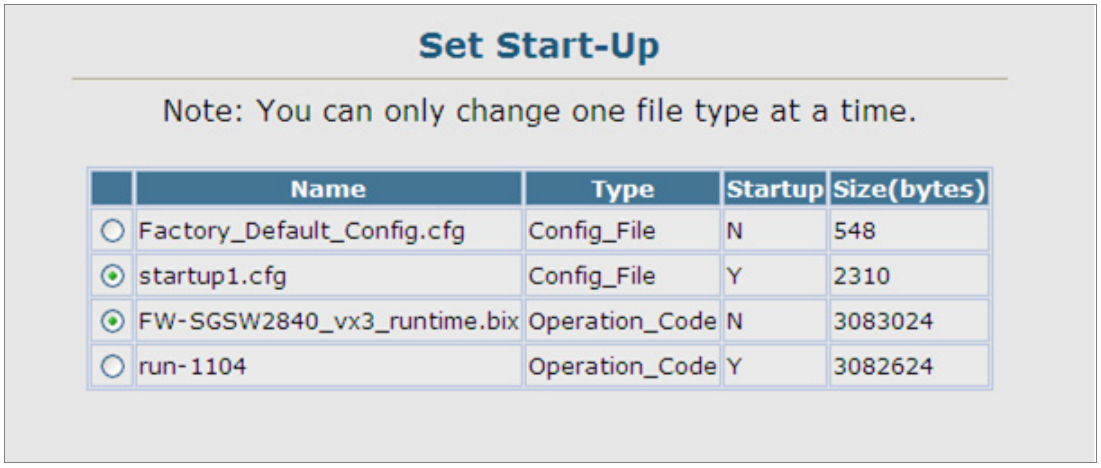


Figure 4-2-8 Set Start-up screenshot

■ Example 2: Downloading System Software from a Server

When downloading runtime code, you can specify the destination file name to replace the current image, or first download the file using a different name from the current runtime code file, and then set the new file as the startup file.

1. Click System, File Management, **Copy Operation**.
2. Select "**tftp to file**" as the file transfer method, enter the **IP address** of the **TFTP server**.
3. Set the file type to "**opcode**," enter the file name of the software to download, select a file on the Managed Switch to overwrite or specify a new file name and click **Apply**.
4. If you replaced the current firmware used for startup and want to start using the new operation code, reboot the system via the System/Reset menu.

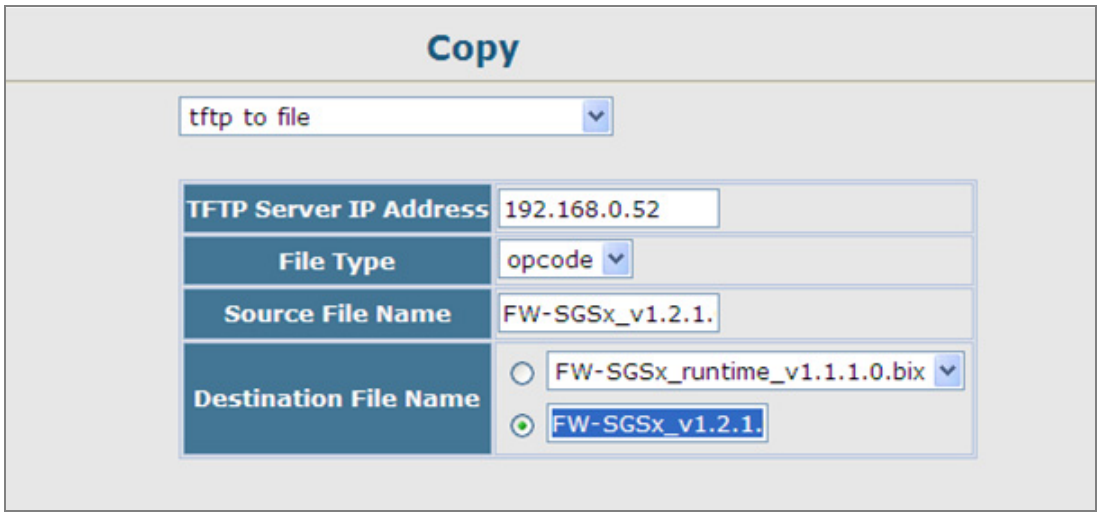


Figure 4-2-9 Download system software screenshot

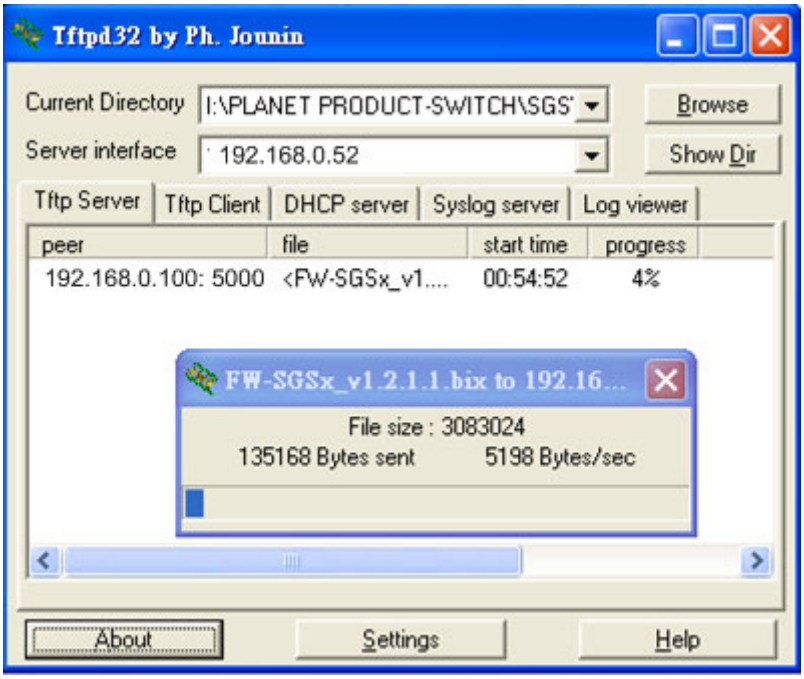


Figure 4-2-10 TFTP Server system software transmit screenshot

- If you download to a new destination file, go to the System / File / **Set Start-Up** menu, mark the operation code file used at startup, and click Apply.
- To start the new firmware, reboot the system via the System / **Reset** menu.
- To delete a file, select System / File Management File / **Delete**. Select the file name from the given list by checking the tick box and click Apply. Note that the file currently designated as the startup code cannot be deleted.

Note

1. Up to **two** copies of the system software (i.e., the runtime firmware) can be stored in the file directory on the Managed Switch.
2. The currently designated startup version of this file cannot be deleted.

Note

The file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

■ Example 3: Downloading Configuration Settings from a Server

You can download the **configuration file** under a new file name and then set it as the startup file, or you can specify the current startup configuration file as the destination file to directly replace it.

1. Click System / File Management / **Copy Operation**.
2. Select "**tftp to startup-config**" as the file transfer method, enter the **IP address** of the TFTP server.
3. Enter the file name of the configuration file to download, select a file on the Managed Switch to overwrite or specify a new file name and click **Apply**.
4. Reboot the system via the System / **Reset** menu.

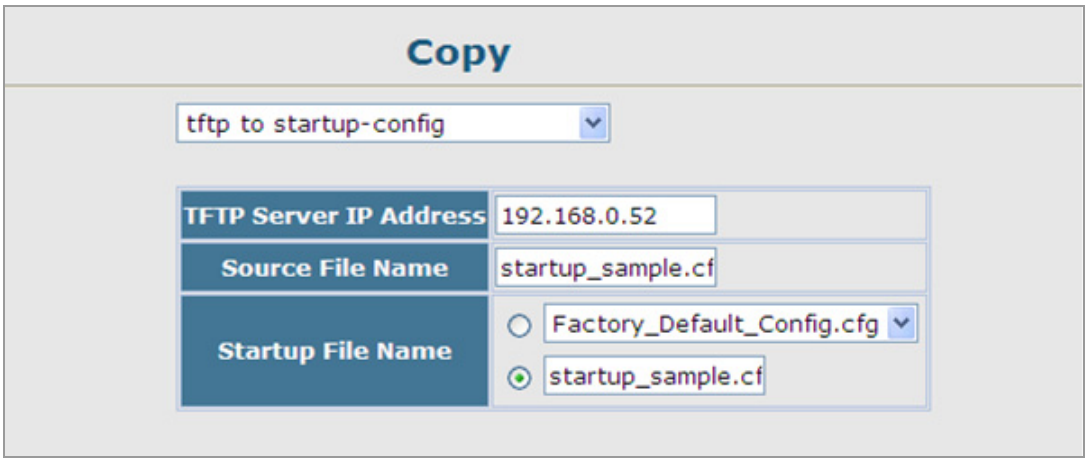


Figure 4-2-11 Download system configuration screenshot

If you download to a new file name using "**tftp to startup-config**" or "**tftp to file**," the file is automatically set as the start-up

configuration file. To use the new settings, reboot the system via the System / **Reset** menu.

■ Example 4: Saving or Restoring Configuration Settings

You can upload/download **configuration settings** to/from a TFTP server. The configuration files can be later downloaded to restore the Managed Switch's settings.

1. Click System / File Management / **Copy Operation**.
2. Select "**running-config to tftp**" or "**startup-config to tftp**" as the file transfer method, enter the **IP address** of the TFTP server.
3. Enter a new file name for the configuration to upload, and click **Apply**.

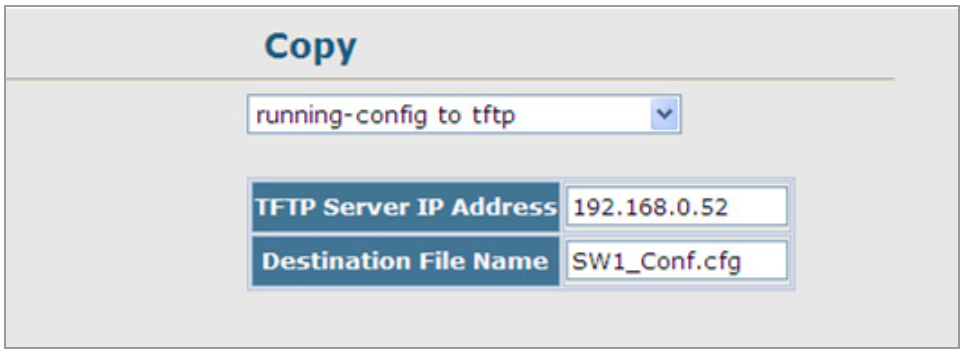


Figure 4-2-12 Upload system configuration screenshot

Note

1. The file "**Factory_Default_Config.cfg**" can be copied to the TFTP server, but cannot be used as the destination on the Managed Switch.
2. The maximum number of user-defined configuration files is limited only by available flash memory space.

4.2.6.2 Delete

To delete a file, select the file name from the given list by checking the tick box and then click Apply. The File Delete screen in Figure 4-2-13 appears.

1. Click System / File Management / **Delete**.
2. Select the file name from the given list by checking the tick box and click Apply.

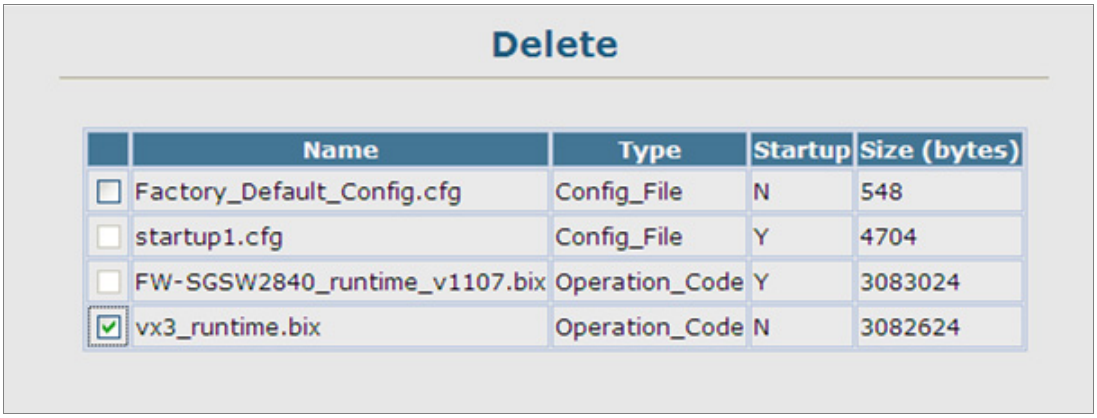


Figure 4-2-13 File Delete screenshot

Note

The currently designated startup version cannot be deleted.

4.2.6.3 Set Startup

You can download a file under a new file name and then set it as the startup file, or you can specify the current startup file as the destination file to directly replace it.

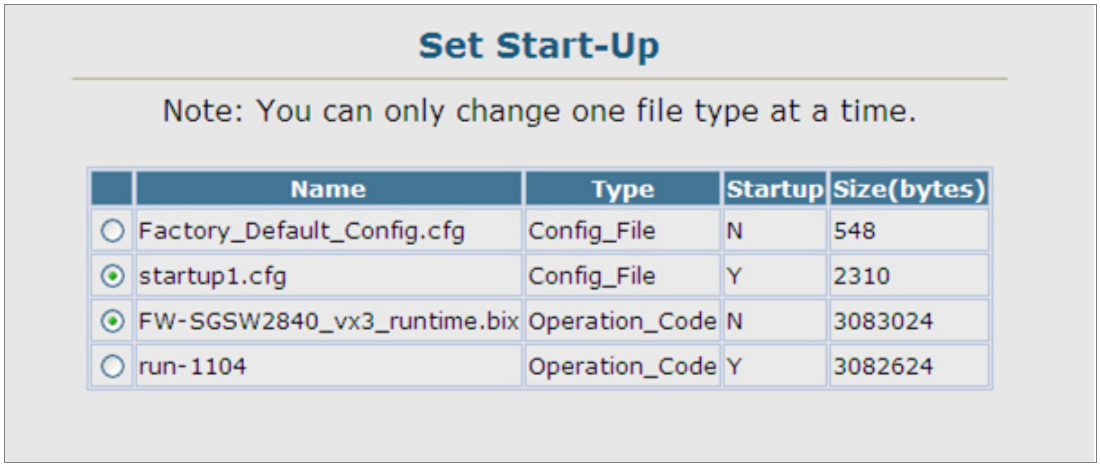


Figure 4-2-14 Set Start-up screenshot

The page includes the following fields:

Object	Description
• **Name**	The name of a file stored on the switch.
• **Type**	Indicates either an operation code file, or a configuration file.
• **Startup**	Shows if this file is used when the system is started.
• **Size**	The length of the file in bytes.

If you download to a new file name using "**tftp to startup-config**"," the file is automatically set as the start-up configuration file. To use the new settings, reboot the system via the Reset page.

The file "**Factory_Default_Config.cfg**" can be copied to the TFTP server, but cannot be used as the destination on the Managed Switch.

4.2.7 Line

You can access the onboard configuration program by attaching a VT100 compatible device to the Managed Switch's serial console port. Management access through the console port is controlled by various parameters, including a password, timeouts, and basic communication settings. These parameters can be configured via the Web or CLI interface.

This section has the following options:

- **Console** Sets console port connection parameters
- **Telnet** Sets Telnet connection parameters

4.2.7.1 Console Port Settings

Specify the console port connection parameters as required, then click **Apply**. The Console Port Settings screen in Figure 4-2-15 appears.

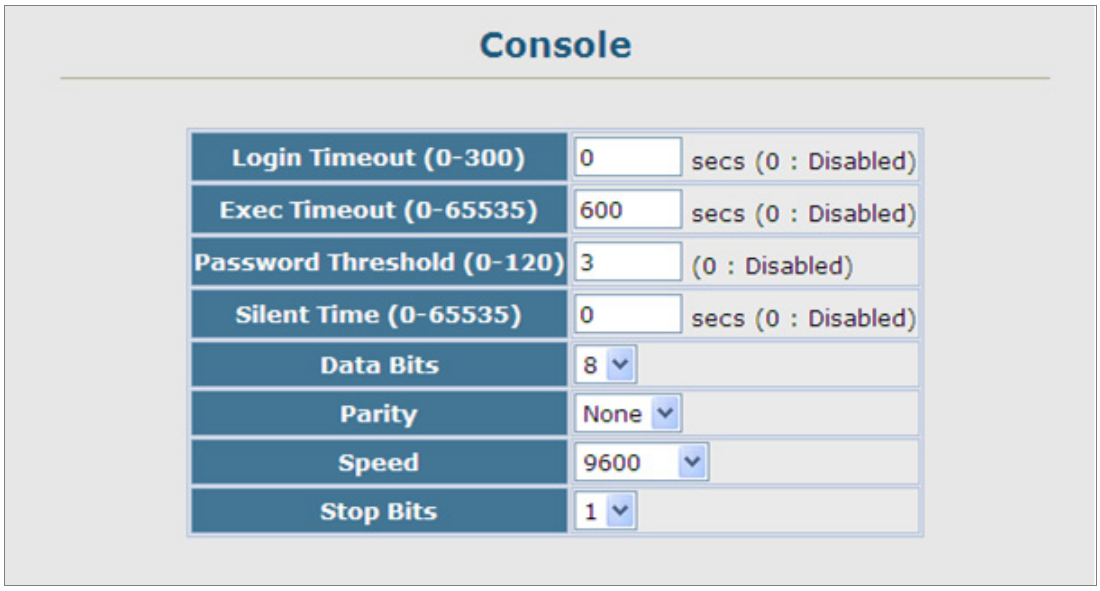


Figure 4-2-15 Console port settings screenshot

The page includes the following fields:

Object	Description
• **Login Timeout**	Sets the interval that the system waits for a user to log into the CLI. If a login attempt is not detected within the timeout interval, the connection is terminated for the session. Range: 0-300 seconds; Default: **0** seconds
• **Exec Timeout**	Sets the interval that the system waits until user input is detected. If user input is not detected within the timeout interval, the current session is terminated.

	Range: 0-65535 seconds; Default: **600** seconds
• **Password Threshold**	Sets the password intrusion threshold, which limits the number of failed logon attempts. When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time (set by the Silent Time parameter) before allowing the next logon attempt. Range: 0-120; Default: **3** attempts
• **Silent Time**	Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts has been exceeded. Range: 0-65535; Default: **0**
• **Data Bits**	Sets the number of data bits per character that are interpreted and generated by the console port. If parity is being generated, specify 7 data bits per character. If no parity is required, specify 8 data bits per character. Default: **8** bits
• **Parity**	Defines the generation of a parity bit. Communication protocols provided by some terminals can require a specific parity bit setting. Specify Even, Odd, or None. Default: **None**
• **Speed**	Sets the terminal line's baud rate for transmit (to terminal) and receive (from terminal). Set the speed to match the baud rate of the device connected to the serial port. Range: 9600, 19200, or 38400 baud; Default: **9600** bps
• **Stop Bits**	Sets the number of the stop bits transmitted per byte. Range: 1-2; Default: **1** stop bit

4.2.7.2 Telnet Settings

You can access the onboard configuration program over the network using Telnet (i.e., a virtual terminal). Management access via Telnet can be enabled / disabled and other various parameters set, including the TCP port number, timeouts, and a password. These parameters can be configured via the web or CLI interface.

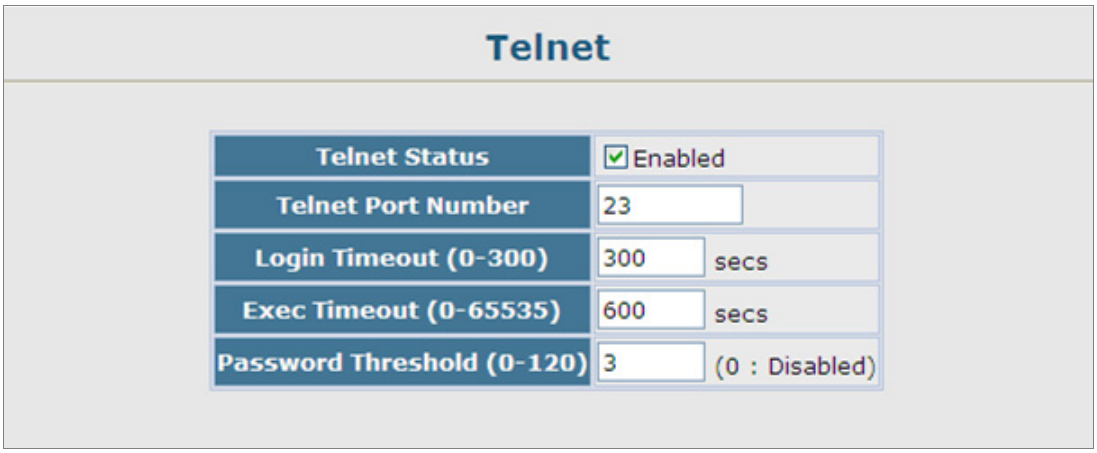


Figure 4-2-16 Telnet setting screenshot

The page includes the following fields:

Object	Description
• **Telnet Status**	Enables or disables Telnet access to the switch. (Default: **Enabled**)
• **Telnet Port Number**	Sets the TCP port number for Telnet on the switch. (Default: **23**)
• **Login Timeout**	Sets the interval that the system waits for a user to log into the (Range: 0-300 seconds; Default: **300** seconds
• **Exec Timeout**	Sets the interval that the system waits until user input is detected. If user input is not detected within the timeout interval, the current session is terminated. Range: 0-65535 seconds; Default: **600** seconds
• **Password Threshold**	Sets the password intrusion threshold, which limits the number of failed logon attempts. When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time (set by the Silent Time parameter) before allowing the next logon attempt. Range: 0-120; Default: **3** attempts

4.2.8 Log

The switch allows you to control the logging of error messages, including the type of events that are recorded in switch memory, logging to a remote System Log (syslog) server, and displays a list of recent event messages. This section has the following options:

- **System Logs** Sends error messages to a logging process
- **Remote Logs** Configures the logging of messages to a remote logging process
- **SMTP** Sends an SMTP client message to a participating server.
- **Logs** Stores and displays error messages

4.2.8.1 System Log Configuration

The system can be configured to send debug and error messages to a logging process. This logging process controls the type of error messages that are stored in switch memory or sent to a remote syslog server.

The system allows you to enable or disable event logging, and specify which levels are logged to RAM or flash memory.

Severe error messages that are logged to flash memory are permanently stored in the switch to assist in troubleshooting network problems. Up to 4096 log entries can be stored in the flash memory, with the oldest entries being overwritten first when the available log memory (256 kilobytes) has been exceeded.

The System Logs page allows you to configure and limit system messages that are logged to flash or RAM memory. The default is for event levels 0 to 3 to be logged to flash and levels 0 to 6 to be logged to RAM.

The following table lists the event levels of the Managed Switch:

Level	Severity Name	Description
7	**Debug**	Debugging messages
6	**Informational**	Informational messages only
5	**Notice**	Normal but significant condition, such as cold start
4	**Warning**	Warning conditions (e.g., return false, unexpected return)
3	**Error**	Error conditions (e.g., invalid input, default used)
2	**Critical**	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
1	**Alert**	Immediate action needed
0	**Emergency**	System unusable

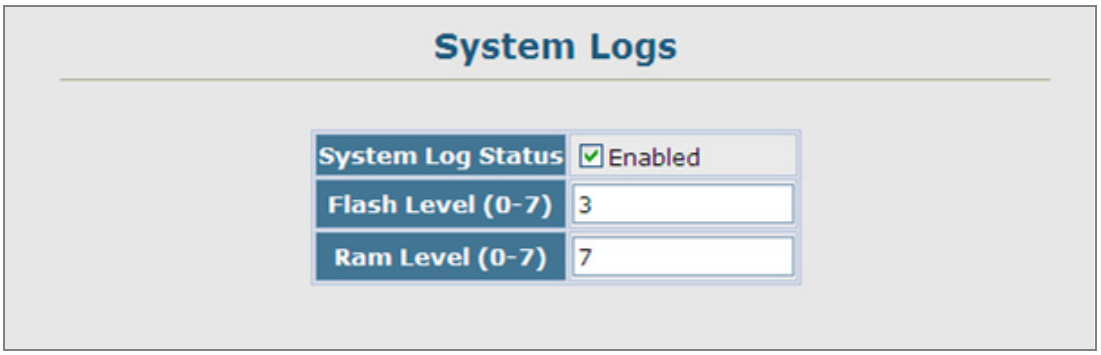


Figure 4-2-17 System Logs screenshot

1. Click System / Log / **System Logs**.
2. Specify System Log Status, set the level of event messages to be logged to RAM and flash memory, then click Apply.

The page includes the following fields:

Object	Description
• **System Log Status**	Enables/disables the logging of debug or error messages to the logging process. (Default: **Enabled**)
• **Flash Level(0-7)**	Limits log messages saved to the switch's permanent flash memory for all levels up to the specified level. For example, if level 3 is specified, all messages from level 0 to level 3 will be logged to flash. Range: 0-7, Default: **3**
• **RAM Level(0-7)**	Limits log messages saved to the switch's temporary RAM memory for all levels up to the specified level. For example, if level 7 is specified, all messages from level 0 to level 7 will be logged to RAM. Range: 0-7, Default: **7**

Note

1. There are only Level 2, 5 and 6 error messages for the current firmware release.
2. The Flash Level must be equal to or less than the RAM Level.

4.2.8.2 Remote Log Configuration

The Remote Logs page allows you to configure the logging of messages that are sent to syslog servers or other management stations. You can also limit the event messages sent to only those messages below a specified level.

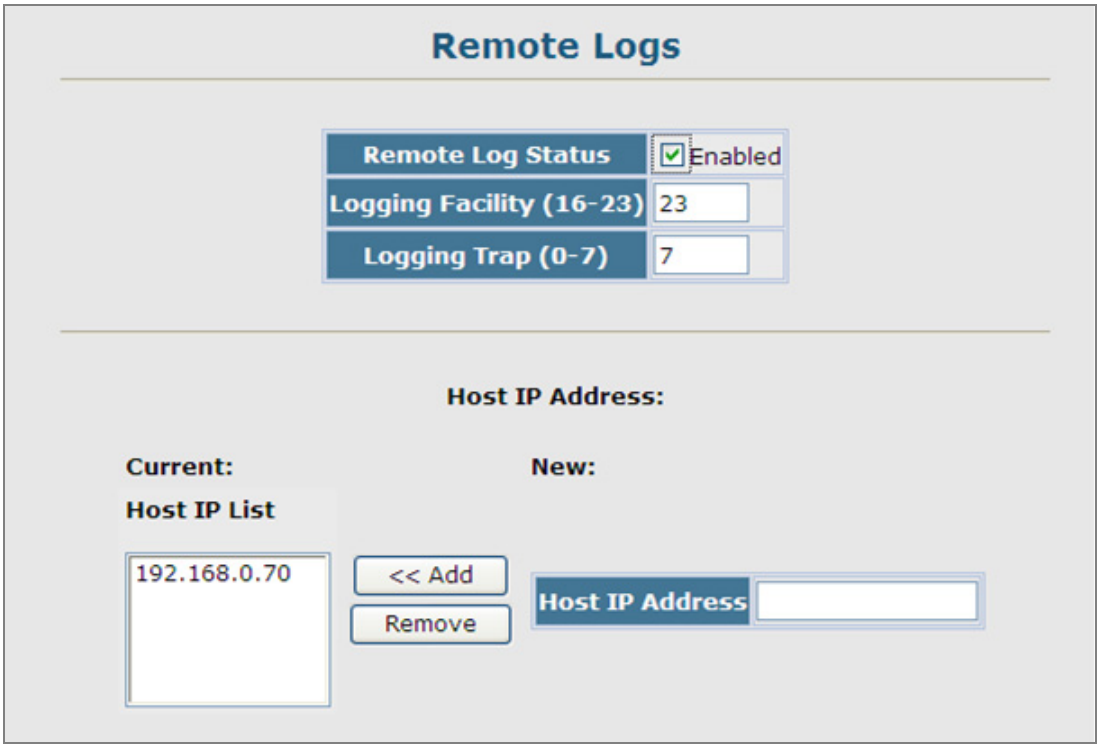


Figure 4-2-18 Remote Logs screenshot

1. Click System, Log, Remote Logs.
2. To add an IP address to the Host IP List, type the new IP address in the Host IP Address box, and then click Add.
3. To delete an IP address, click the entry in the Host IP List, and then click Remove.

The page includes the following fields:

Object	Description
• **Remote Log Status**	Enables/disables the logging of debug or error messages to the remote logging process. (Default: **Enabled**)
• **Logging Facility**	Sets the facility type for remote logging of syslog messages. There are eight facility types specified by values of 16 to 23. The facility type is used by the syslog server to dispatch log messages to an appropriate service. The attribute specifies the facility type tag sent in syslog messages. (See RFC 3164.) This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to process messages, such as sorting or storing messages in the corresponding database.

	Range: 16-23, Default: **23**
• **Logging Trap**	Limits log messages that are sent to the remote syslog server for all levels up to the specified level. For example, if level 3 is specified, all messages from level 0 to level 3 will be sent to the remote server. Range: 0-7, Default: **7**
• **Host IP List**	Displays the list of remote server IP addresses that receive the syslog messages. The maximum number of host IP addresses allowed is five.
• **Host IP Address**	Specifies a new server IP address to add to the Host IP List.

Note

Host IP Address = **Syslog Server** IP address

4.2.8.3 Displaying Log Messages

The Logs page allows you to scroll through the logged system and event messages. The Managed Switch can store up to 2048 log entries in temporary random access memory (RAM; i.e., memory flushed on power reset) and up to 4096 entries in permanent flash memory.

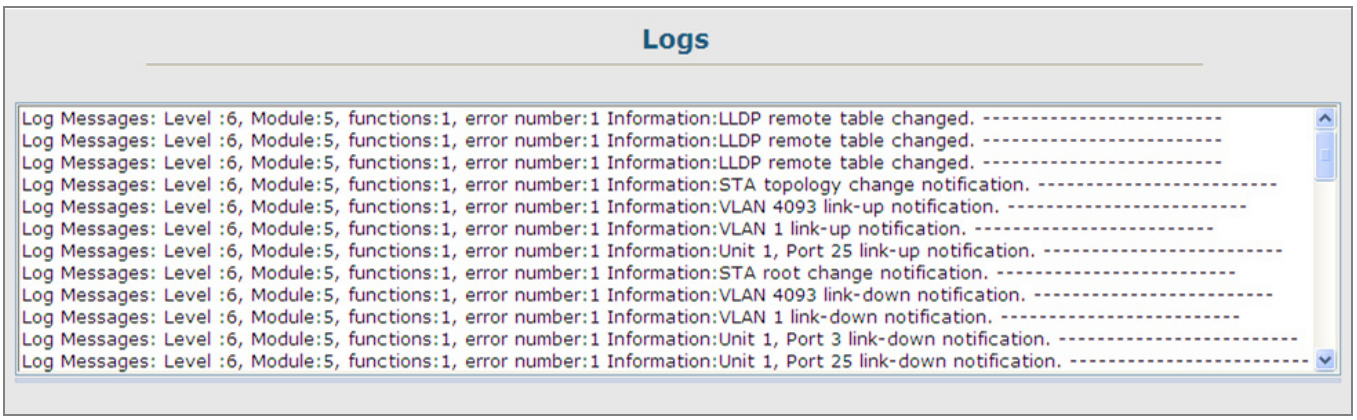


Figure 4-2-19 System and event logs screenshot

4.2.8.4 SMTP E-Mail Alert

To alert system administrators of problems, the Managed Switch can use **SMTP** (**Simple Mail Transfer Protocol**) to send email messages when triggered by logging events of a specified level. The messages are sent to specified SMTP servers on the network and can be retrieved using POP or IMAP clients.

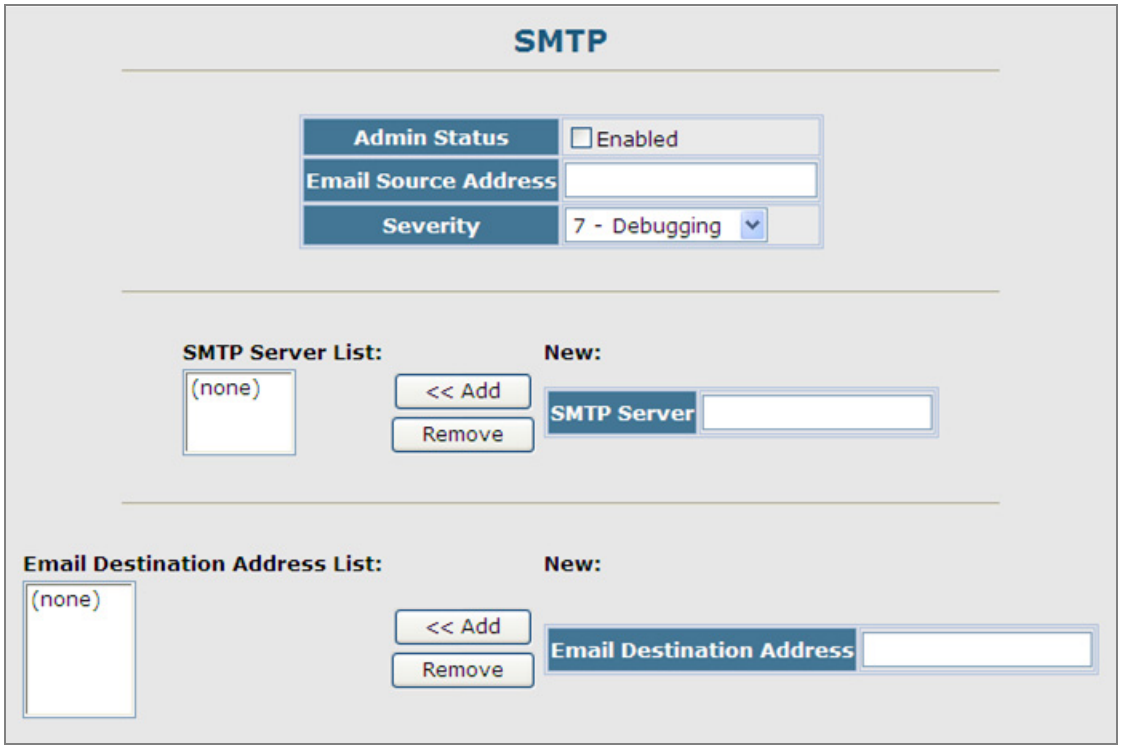


Figure 4-2-20 SMTP Configuration page screenshot

1. Click System, Log, **SMTP**.
2. To add an **SMTP MAIL Server** IP address to the **Server IP** List, type the new IP address in the Server IP Address box, and then click Add.
3. To delete an IP address, click the entry in the Server IP List, and then click Remove.

The page includes the following fields:

Object	Description
• **Admin Status**	Enables/disables the SMTP function. (Default: **Disabled**)
• **Email Source Address**	Sets the email address used for the "From" field in alert messages. You may use a symbolic email address that identifies the switch, or the address of an administrator responsible for the Managed Switch.
• **Severity**	Sets the syslog severity threshold level used to trigger alert messages. All events at this level or higher will be sent to the configured email recipients.

	For example, using Level 7 will report all events from level 7 to level 0. (Default: Level **7**)
• **SMTP Server List**	Specifies a list of up to three recipient SMTP servers. The Managed Switch attempts to connect to the other listed servers if the first fails. Use the New SMTP Server text field and the Add/Remove buttons to configure the list.
• **Email Destination Address List**	Specifies the email recipients of alert messages. You can specify up to five recipients. Use the New Email Destination Address text field and the Add/Remove buttons to configure the list.

Note

1. The Managed Switch doesn't support DNS protocol, to make the SMTP alert receiver to get the e-mail send by the Managed Switch; the correct SMTP Server's IP address has to be field in the Server List. Check the correct IP address of the Mail Server before enter the field.
2. It is recommended to send a test e-mail to make sure you can receive the alert mails.

■ **Example: SMTP Configuration Sample**

In this SMTP example, the Mail server's IP address is 220.128.188.248. The email account kentk@plant.com.tw is one of the legal account in the mail domain, once there is a level 7 event occurred, the Managed Switch will send a alert email to supports@planet.com.tw

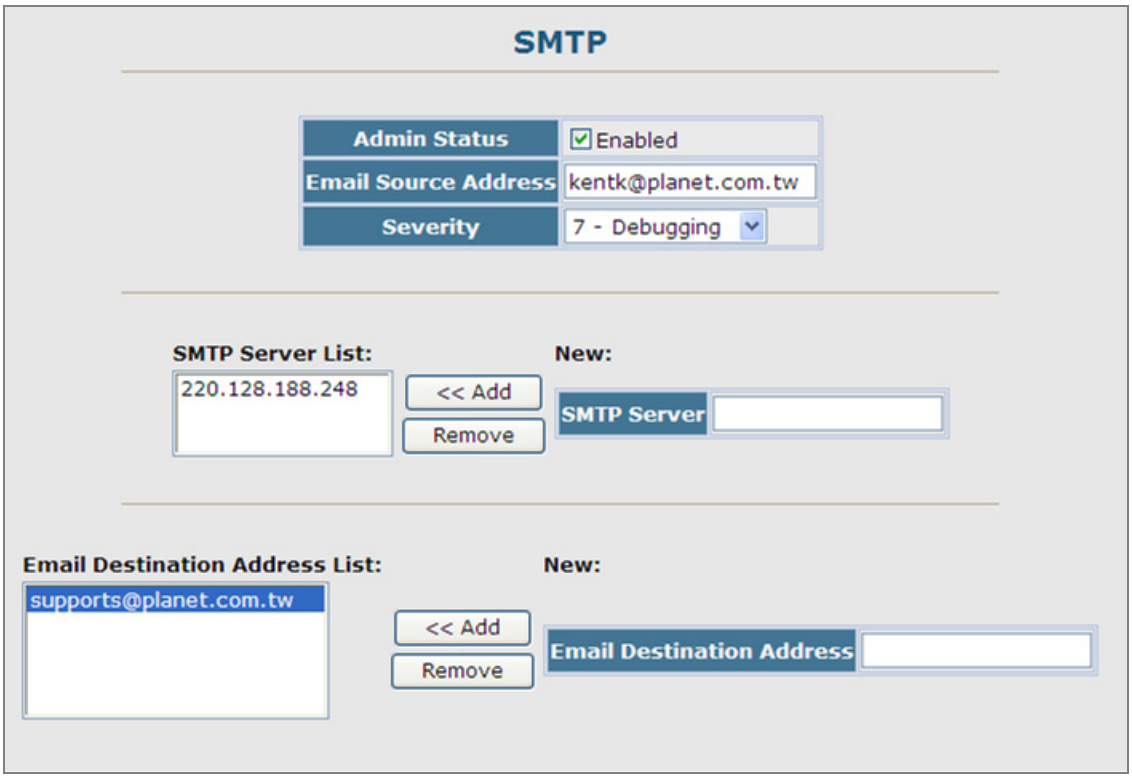


Figure 4-2-21 SMTP Configuration sample screenshot

4.2.9 UPNP

Universal Plug and Play (UPnP) is a set of protocols that allows devices to connect seamlessly and simplifies the deployment of home and office networks. UPnP achieves this by issuing UPnP device control protocols designed upon open, Internet-based communication standards.

The first step in UPnP networking is discovery. When a device is added to the network, the UPnP discovery protocol allows that device to broadcast its services to control points on the network. Similarly, when a control point is added to the network, the UPnP discovery protocol allows that control point to search for UPnP enabled devices on the network.

Once a control point has discovered a device its next step is to learn more about the device and its capabilities by retrieving the device's description from the URL provided by the device in the discovery message. After a control point has retrieved a description of the device, it can send actions to the devices service. To do this, a control point sends a suitable control message to the control URL for the service (provided in the device description).

When a device is known to the control point, periodic event notification messages are sent. An UPnP description for a service includes a list of actions the service responds to and a list of variables that model the state of the service at run time.

If a device has a URL for presentation, then the control point can retrieve a page from this URL, load the page into a Web browser and depending on the capabilities of the page, allows a user to control the device and/or view device status.

UPnP Configuration

This page allows you to enable or disable UPnP, and to set time out values.

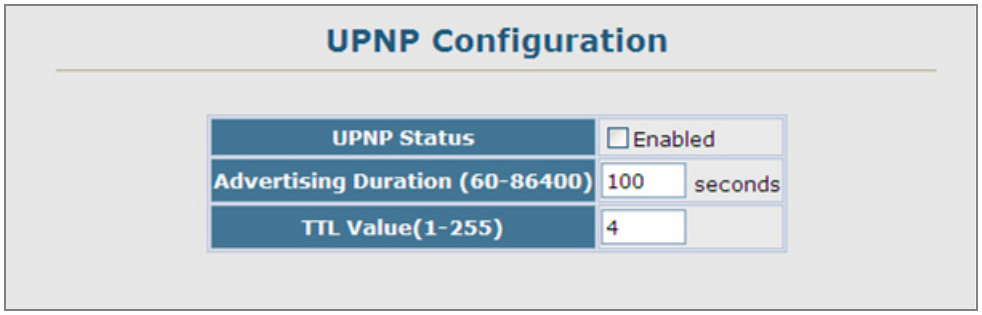


Figure 4-2-22 UPnP Configuration page screenshot

Object	Description
• **UPNP Status**	Enables/disables UPnP on the device.
• **Advertising Duration**	This sets the duration of which a device will advertise its status to the control point. Range: 60-86400 seconds; Default: **100** seconds

• **TTL Value**	Sets the time-to-live (TTL) value for UPnP messages transmitted by the device. Range: 1-255; Default: **4**

4.2.10 Reset

Reset the Managed Switch. The Managed Switch's configuration will not be saved automatically; you have to save the configuration manually before system reboot.

1. Click System, Reset.
2. Click the Reset button to reboot the Managed Switch.
3. When prompted, confirm that you want reset the switch.

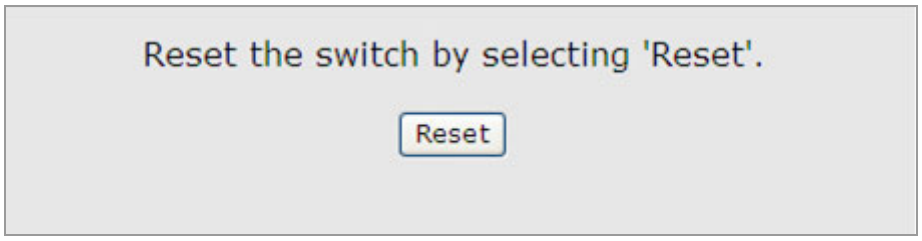


Figure 4-2-23 Reset page screenshot

Figure 4-2-24 Reset page screenshot

Note

When restarting the system, it will always run the Power-On Self-Test.

4.2.11 SNTP

Simple Network Time Protocol (SNTP) allows the Managed Switch to set its internal clock based on periodic updates from a time server (SNTP or NTP). Maintaining an accurate time on the Managed Switch enables the system log to record meaningful dates and times for event entries. You can also set the clock manually. If the clock is not set, the Managed Switch will only record the time from the factory default set at the last bootup.

When the SNTP client is enabled, the switch periodically sends a request for a time update to a configured time server. You can configure up to three time server IP addresses. The switch will attempt to poll each server in the configured sequence.

4.2.11.1 SNTP Configuration

You can configure the Managed Switch to send time synchronization requests to specific time servers (i.e., client mode), update its clock based on broadcasts from time servers, or use both methods. When both methods are enabled, the Managed Switch will update its clock using information broadcast from time servers, but will query the specified server(s) if a broadcast is not received with the polling interval.

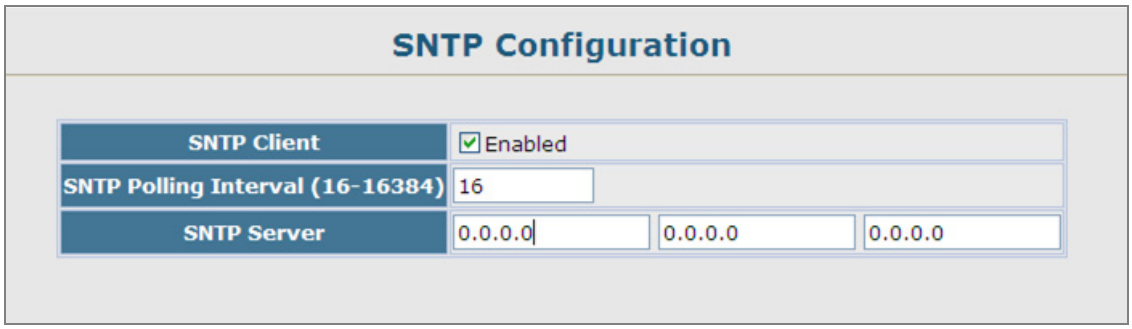


Figure 4-2-25 SNTP Configuration page screenshot

The page includes the following fields:

Object	Description
• **SNTP Client**	Configures the Managed Switch to operate as an SNTP client. This requires at least one time server to be specified in the SNTP Server field. (Default: Disabled)
• **SNTP Poll Interval**	Sets the interval between sending requests for a time update from a time server. (Range: 16-16384 seconds; Default: 16 seconds)
• **SNTP Server**	Sets the IP address for up to three time servers. The Managed Switch attempts to update the time from the first server, if this fails it attempts an update from the next server in the sequence.

4.2.11.2 Clock Time Zone

SNTP uses Coordinated Universal Time (or UTC, formerly Greenwich Mean Time, or GMT) based on the time at the Earth's prime meridian, zero degrees longitude. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC.

Figure 4-2-26 Clock Time Zone page screenshot

The page includes the following fields:

Object	Description
• **Current Time**	Displays the current time.
• **Name**	Assigns a name to the time zone. (Range: 1-29 characters)
• **Hours (0-12)**	The number of hours before/after UTC.
• **Minutes (0-59)**	The number of minutes before/after UTC.
• **Direction**	Configures the time zone to be before (east) or after (west) UTC

4.2.12 LLDP

Link Layer Discovery Protocol (LLDP) is used to discover basic information about neighboring devices on the local broadcast domain. LLDP is a Layer 2 protocol that uses periodic broadcasts to advertise information about the sending device. Advertised information is represented in **Type Length Value (TLV)** format according to the IEEE 802.1ab standard, and can include details such as device identification, capabilities and configuration settings. LLDP also defines how to store and maintain information gathered about the neighboring network nodes it discovers.

Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

4.2.12.1 LLDP Configuration

Setting LLDP Timing Attributes

Use the LLDP Configuration screen to set attributes for general functions such as globally enabling LLDP on the Managed Switch, setting the message ageout time, and setting the frequency for broadcasting general advertisements or reports about changes in the LLDP MIB.

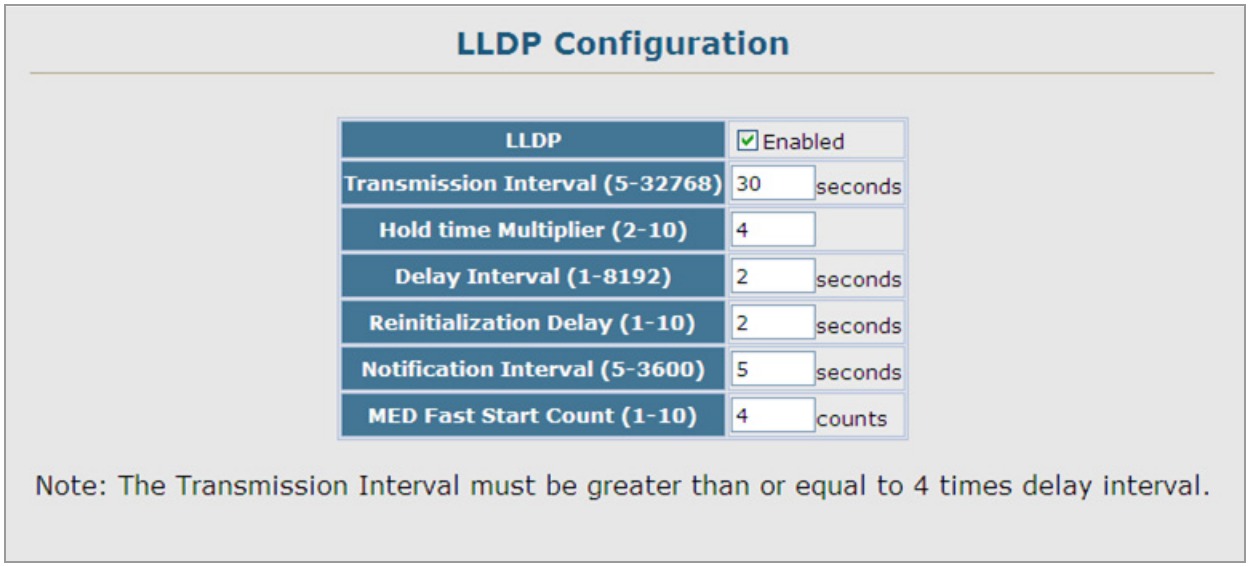


Figure 4-2-27 LLDP Configuration page screenshot

The page includes the following fields:

Object	Description
• **LLDP**	Enables LLDP globally on the switch. Default: **Enabled**
• **Transmission Interval**	Configures the periodic transmit interval for LLDP advertisements. Range: 5-32768seconds;

	Default: **30** seconds This attribute must comply with the following rule: (Transmission Interval * Hold Time Multiplier) ≤65536, and Transmission Interval >= (4 * Delay Interval)
• **Hold Time Multiplier**	Configures the **time-to-live (TTL)** value sent in LLDP advertisements as shown in the formula below. Range: 2-10; Default: **4** The time-to-live tells the receiving LLDP agent how long to retain all information pertaining to the sending LLDP agent if it does not transmit updates in a timely manner. TTL in seconds is based on the following rule: (Transmission Interval * Holdtime Multiplier) ≤ 65536. Therefore, the default TTL is 4*30 = 120 seconds.
• **Delay Interval**	Configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables. Range: 1-8192 seconds; Default: **2** seconds The transmit delay is used to prevent a series of successive LLDP transmissions during a short period of rapid changes in local LLDP MIB objects, and to increase the probability that multiple, rather than single changes, are reported in each transmission. This attribute must comply with the rule: (4 * Delay Interval) ≤Transmission Interval
• **Reinitialization Delay**	Configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down. Range: 1-10 seconds; Default: **2** seconds When LLDP is re-initialized on a port, all information in the remote systems LLDP MIB associated with this port is deleted.
• **Notification Interval**	Configures the allowed interval for sending SNMP notifications about LLDP MIB changes. Range: 5-3600 seconds;

	Default: **5** seconds This parameter only applies to SNMP applications which use data stored in the LLDP MIB for network monitoring or management. Information about changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.
• **MED Fast Start Count**	Configures the amount of LLDP MED Fast Start LLDPDUs to transmit during the activation process of the LLDP-MED Fast Start mechanisim. Range: 1-10 packets; Default: **4** packets The MED Fast Start Count parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

4.2.12.2 LLDP Port Configuration

Use the LLDP Port Configuration to specify the message attributes for individual interfaces, including whether messages are transmitted, received, or both transmitted and received, whether SNMP notifications are sent, and the type of information advertised.

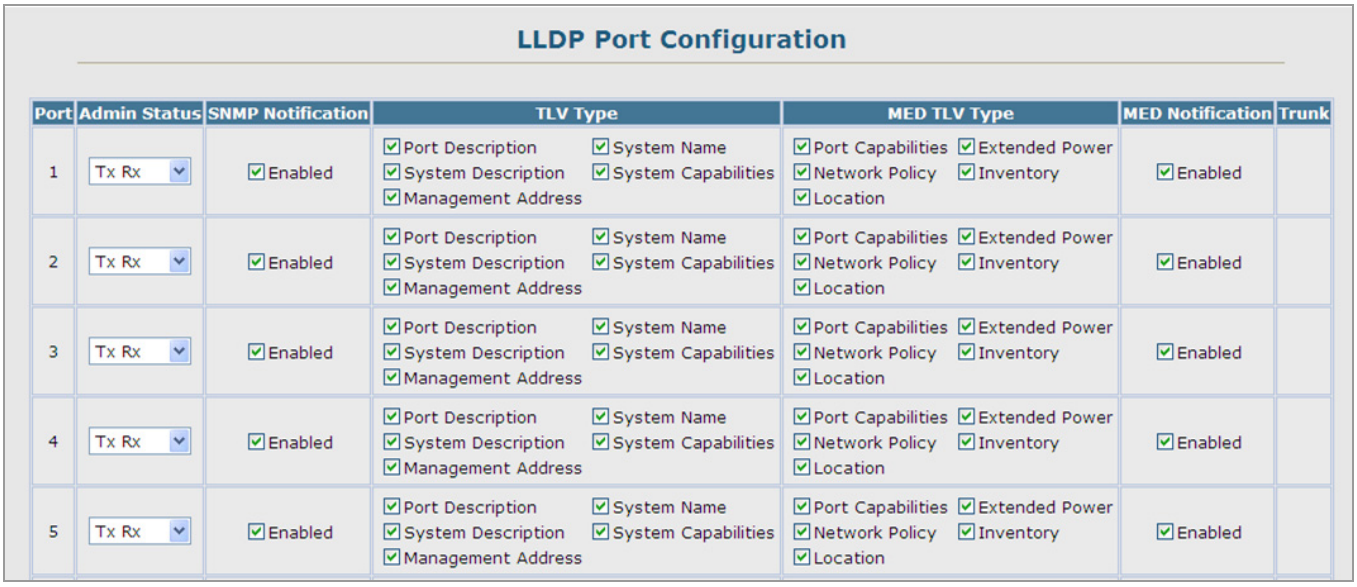


Figure 4-2-28 LLDP Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Admin Status**	Enables LLDP message transmit and receive modes for LLDP Protocol Data Units. ■ **Options:** ■ **Tx only** ■ **Rx only** ■ **TxRx** ■ **Disabled** Default: **TxRx**
• **SNMP Notification**	Enables the transmission of SNMP trap notifications about LLDP and LLDP-MED changes. (Default: Enabled) This option sends out SNMP trap notifications to designated target stations at the interval specified by the Notification Interval in the preceding section. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA-1057), or vendor-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs. For information on defining SNMP trap destinations. Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.
• **TLV Type**	Configures the information included in the TLV field of advertised messages. **-Port Description** – The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software. **-System Description** – The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software. **-Management Address** – The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement. The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications in the performance of network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity

	MIB. Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV. Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV. **-System Name** – The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name. To configure the system name, see "Displaying System Information" on page 3-12. **-System Capabilities** – The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB.
• **MED TLV Type**	Configures the information included in the MED TLV field of advertised messages. **-Port Capabilities** – This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch. **-Network Policy** – This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper network policy configurations frequently result in voice quality degradation or complete service disruption. **-Location** – This option advertises location identification details. **-Extended Powe**r – This option advertises extended Power-over-Ethernet capability details, such as power availability from the switch, and power state of the switch, including whether the switch is operating from primary or backup power (the Endpoint Device could use this information to decide to enter power conservation mode). Note that this device does not support PoE capabilities. **-Inventory** – This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information.
• **MED Notification**	Enables the transmission of SNMP trap notifications about LLDP-MED changes. (Default: Enabled)
• **Trunk**	Shows if the port is a member of a trunk.

4.2.12.3 LLDP Trunk Configuration

Use the LLDP Trunk Configuration to specify the message attributes for individual interfaces, including whether messages are transmitted, received, or both transmitted and received, whether SNMP notifications are sent, and the type of information advertised.

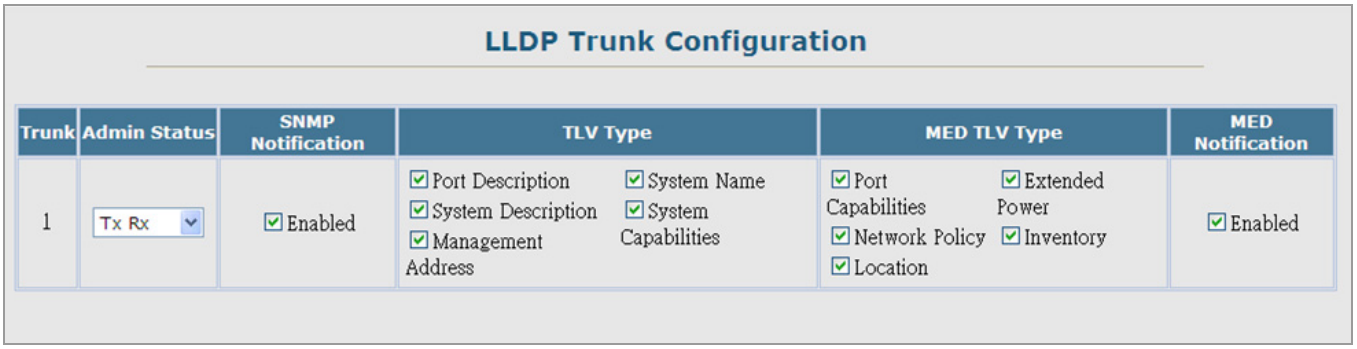


Figure 4-2-29 LLDP Trunk Configuration page screenshot

The page includes the following fields:

Object	Description
• **Admin Status**	Enables LLDP messages transmit and receive modes for LLDP Protocol Data Units. Options: ■ **Tx only** ■ **Rx only** ■ **TxRx** ■ **Disabled** Default: **TxRx**
• **SNMP Notification**	Enables the transmission of SNMP trap notifications about LLDP and LLDP-MED changes. Default: **Enabled** This option sends out SNMP trap notifications to designated target stations at the interval specified by the Notification Interval in the preceding section. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA-1057), or vendor-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs. For information on defining SNMP trap destinations, see "Specifying Trap Managers and Trap Types" on page 3-42. Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of

	lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.
• **TLV Type**	Configures the information included in the TLV field of advertised messages. **-Port Description** – The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software. **-System Description** – The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software. **-Management Address** – The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement. The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications in the performance of network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity MIB. Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV. Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV. **-System Name** – The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name. To configure the system name, see "Displaying System Information". **-System Capabilities** – The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB.
• **MED TLV Type**	Configures the information included in the MED TLV field of advertised messages. **-Port Capabilities** – This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch.

	-Network Policy – This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper network policy configurations frequently result in voice quality degradation or complete service disruption. **-Location** – This option advertises location identification details. **-Extended Powe**r – This option advertises extended Power-over-Ethernet capability details, such as power availability from the switch, and power state of the switch, including whether the switch is operating from primary or backup power (the Endpoint Device could use this information to decide to enter power conservation mode). Note that this device does not support PoE capabilities. **-Inventory** – This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information.
• **MED Notification**	Enables the transmission of SNMP trap notifications about LLDP-MED changes. (Default: **Enabled**)
• **Trunk**	Shows if the port is a member of a trunk.

4.2.12.4 LLDP Local Device Information

Use the LLDP Local Device Information screen to display information about the switch, such as its **MAC address**, **chassis ID**, **management IP address**, and **port information**.

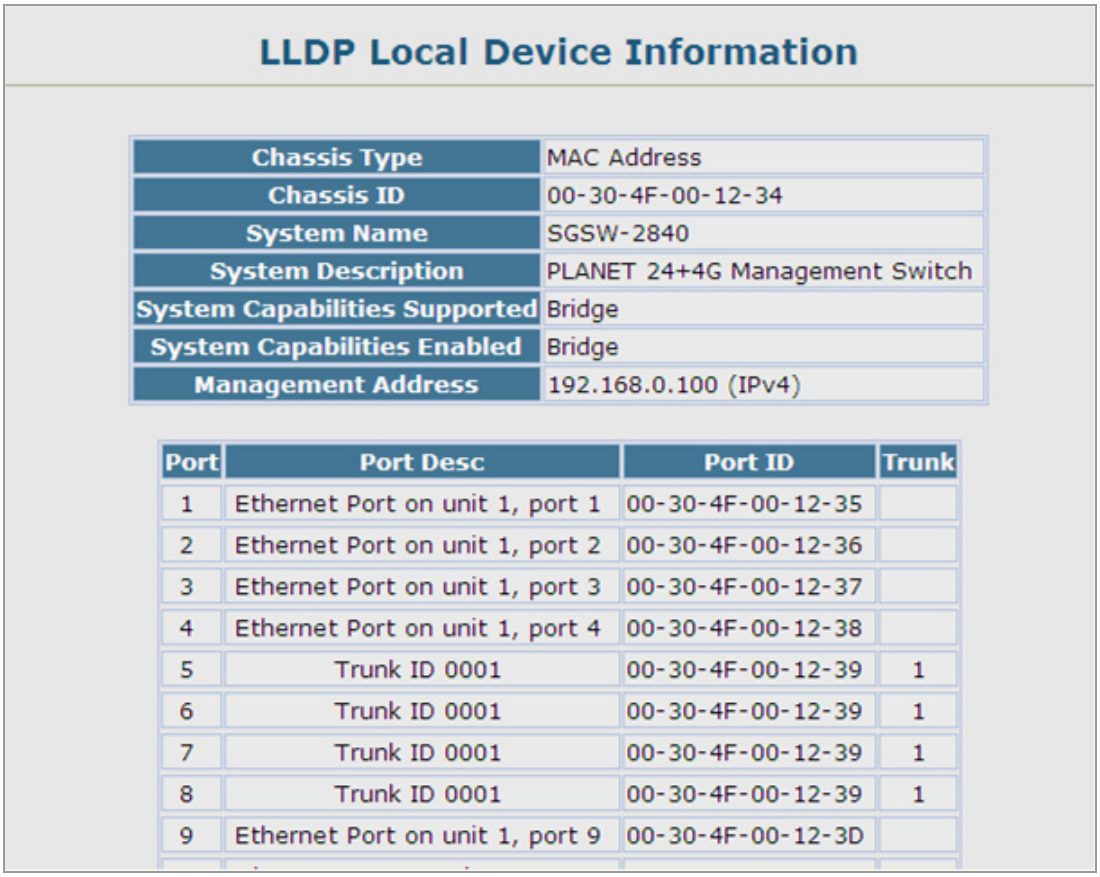


Figure 4-2-30 LLDP Local Device Information page screenshot

The page includes the following fields:

Object	Description
• **Chassis Type**	Identifies the chassis containing the IEEE 802 LAN entity associated with the transmitting LLDP agent. There are several ways in which a chassis may be identified and a chassis ID subtype is used to indicate the type of component being referenced by the chassis ID field.
• **Chassis ID**	An octet string indicating the specific identifier for the particular chassis in this system.
• **System Name**	An string that indicates the system's administratively assigned name (see "**Displaying System Information**").
• **System Description**	A textual description of the network entity. This field is also displayed by the show system command.
• **System Capabilities**	The capabilities that define the primary function(s) of the system.

Supported	
• **System Capabilities Enabled**	The primary function(s) of the system which are currently enabled. Refer to the preceding table.
• **Management Address**	The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.

ID Basis	Reference
Chassis component	EntPhysicalAlias when entPhysClass has a value of 'chassis(3)' (IETF RFC 2737)
Interface alias	IfAlias (IETF RFC 2863)
Port component	EntPhysicalAlias when entPhysicalClass has a value 'port(10)' or 'backplane(4)' (IETF RFC 2737)
MAC address	MAC address (IEEE Std 802-2001)
Network address	networkAddress
Interface name	ifName (IETF RFC 2863)
Locally assigned	locally assigned

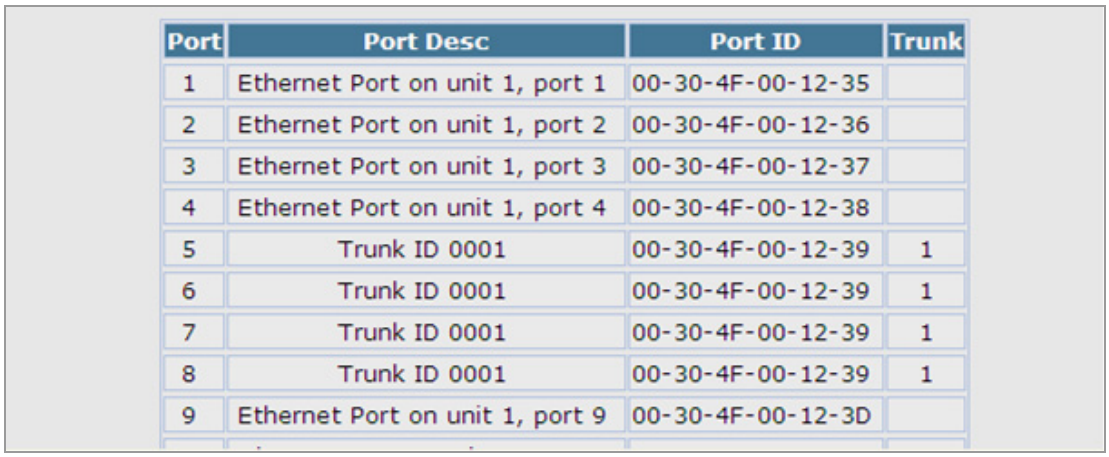
Table 4-2-1 Chassis ID Subtype

ID Basis	Reference
Other	—
Repeater	IETF RFC 2108
Bridge	IETF RFC 2674
WLAN Access Point	IEEE 802.11 MIB
Router	IETF RFC 1812
Telephone	IETF RFC 2011
DOCSIS cable device	IETF RFC 2669 and IETF RFC 2670
End Station Only	IETF RFC 2011

Table 4-2-2 System Capabilities

Interface Settings

The attributes listed below apply to both port and trunk interface types. When a trunk is listed, the descriptions apply to the first port of the trunk.



Port	Port Desc	Port ID	Trunk
1	Ethernet Port on unit 1, port 1	00-30-4F-00-12-35	
2	Ethernet Port on unit 1, port 2	00-30-4F-00-12-36	
3	Ethernet Port on unit 1, port 3	00-30-4F-00-12-37	
4	Ethernet Port on unit 1, port 4	00-30-4F-00-12-38	
5	Trunk ID 0001	00-30-4F-00-12-39	1
6	Trunk ID 0001	00-30-4F-00-12-39	1
7	Trunk ID 0001	00-30-4F-00-12-39	1
8	Trunk ID 0001	00-30-4F-00-12-39	1
9	Ethernet Port on unit 1, port 9	00-30-4F-00-12-3D	

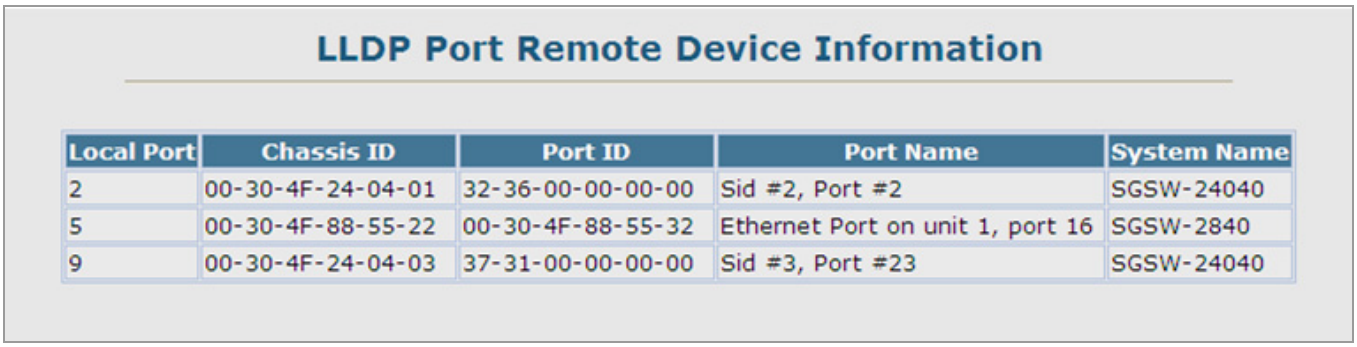
Figure 4-2-31 Interface Settings page screenshot

The page includes the following fields:

Object	Description
• **Port Description**	A string that indicates the port's description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
• **Port ID**	A string that contains the specific identifier for the port from which this LLDPDU was transmitted.

4.2.12.5 Remote Port Information

Use the LLDP Remote Port/Trunk Information screen to display information about devices connected directly to the switch's ports which are advertising information through LLDP.



LLDP Port Remote Device Information

Local Port	Chassis ID	Port ID	Port Name	System Name
2	00-30-4F-24-04-01	32-36-00-00-00-00	Sid #2, Port #2	SGSW-24040
5	00-30-4F-88-55-22	00-30-4F-88-55-32	Ethernet Port on unit 1, port 16	SGSW-2840
9	00-30-4F-24-04-03	37-31-00-00-00-00	Sid #3, Port #23	SGSW-24040

Figure 4-2-32 LLDP Configuration page screenshot

The page includes the following fields:

Object	Description
• **Local Port**	The local port to which a remote LLDP-capable device is attached.
• **Chassis ID**	An octet string indicating the specific identifier for the particular chassis in this

	system.
• **Port ID**	A string that contains the specific identifier for the port from which this LLDPDU was transmitted.
• **Port Name**	A string that indicates the port's description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
• **System Name**	An string that indicates the system's administratively assigned name.

4.2.12.6 LLDP Remote Information Detail

Use the LLDP Remote Information Details screen to display detailed information about an LLDP-enabled device connected to a specific port on the local switch.

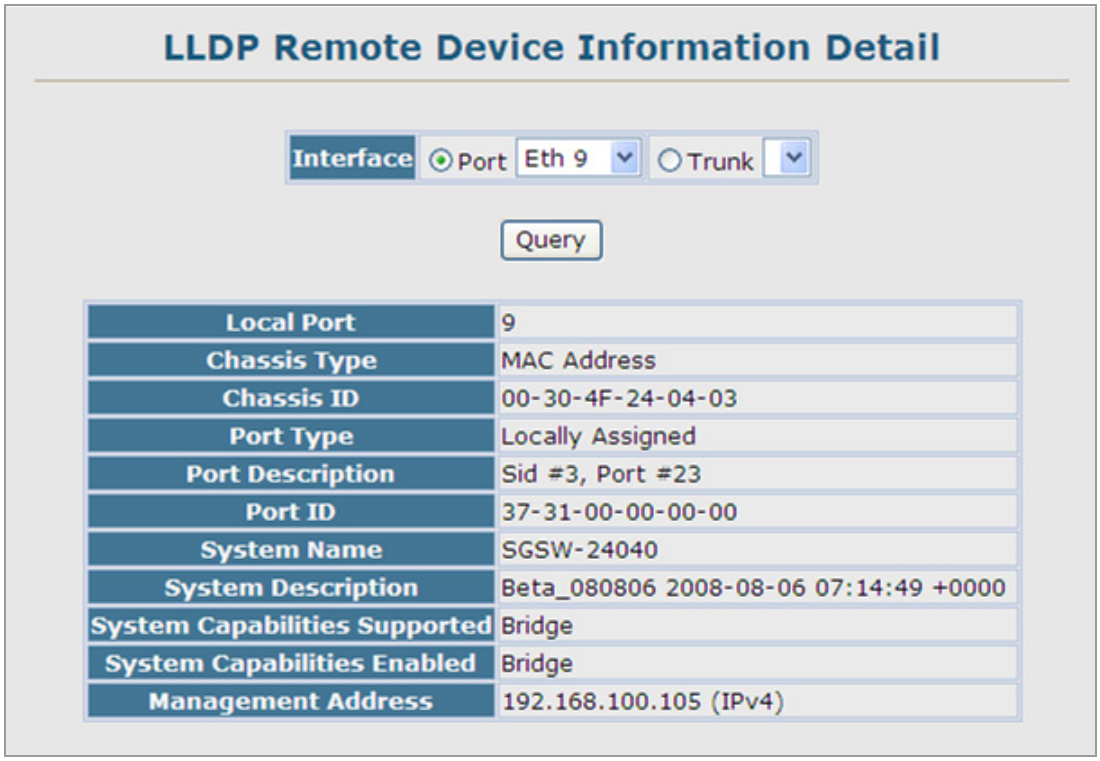


Figure 4-2-33 LLDP Configuration page screenshot

The page includes the following fields:

Object	Description
• **Local Port**	The local port to which a remote LLDP-capable device is attached.
• **Chassis Type**	Identifies the chassis containing the IEEE 802 LAN entity associated with the transmitting LLDP agent. There are several ways in which a chassis may be identified and a chassis ID subtype is used to indicate the type of component being referenced by the chassis ID field.

	(See Table 4-2-1, "Chassis ID Subtype,)
• **Chassis ID**	An octet string indicating the specific identifier for the particular chassis in this system.
• **Port Type**	Indicates the basis for the identifier that is listed in the Port ID field.
• **System Name**	An string that indicates the system's administratively assigned name.
• **System Description**	A textual description of the network entity.
• **System Capabilities Supported**	The capabilities that define the primary function(s) of the system. (See Table 4-2-2, "System Capabilities,)
• **System Capabilities Enabled**	The primary function(s) of the system which are currently enabled. Refer to the preceding table. (See Table 4-2-2, "System Capabilities,)
• **Management Address**	The IPv4 address of the remote device. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.

ID Basis	Reference
Interface alias	IfAlias (IETF RFC 2863)
Chassis component	EntPhysicalAlias when entPhysClass has a value of 'chassis(3)' (IETF RFC 2737)
Port component	EntPhysicalAlias when entPhysicalClass has a value 'port(10)' or 'backplane(4)' (IETF RFC 2737)
MAC address	MAC address (IEEE Std 802-2001)
Network address	networkAddress
Interface name	ifName (IETF RFC 2863)
Agent circuit ID	agent circuit ID (IETF RFC 3046)
Locally assigned	locally assigned

Table 4-2-3 Port ID Subtype

4.2.12.7 LLDP Device Statistics

Use the LLDP Device Statistics screen to general statistics for LLDP-capable devices attached to the switch, and for LLDP protocol messages transmitted or received on all local interfaces.

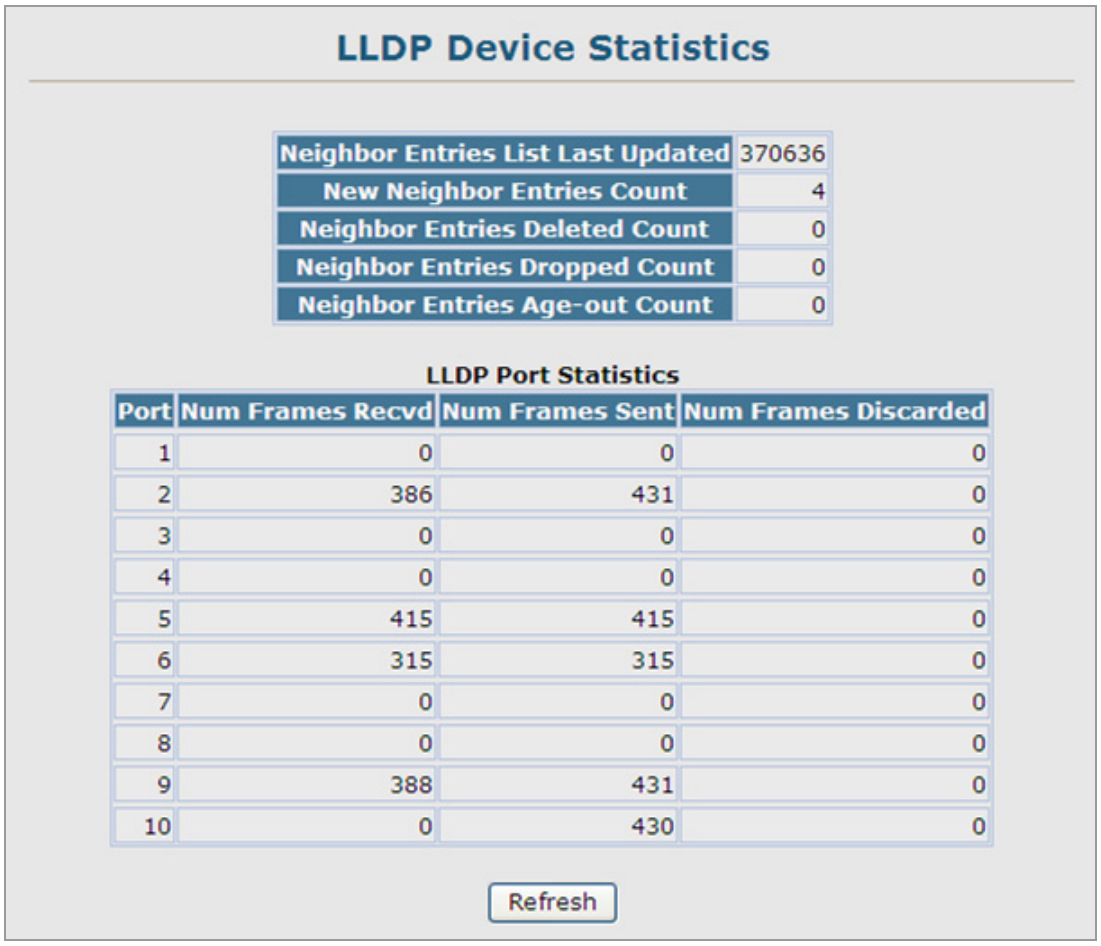

LLDP Device Statistics
Neighbor Entries List Last Updated 370636
New Neighbor Entries Count 4
Neighbor Entries Deleted Count 0
Neighbor Entries Dropped Count 0
Neighbor Entries Age-out Count 0
LLDP Port Statistics
Port Num Frames Recvd Num Frames Sent Num Frames Discarded
1 0 0 0
2 386 431 0
3 0 0 0
4 0 0 0
5 415 415 0
6 315 315 0
7 0 0 0
8 0 0 0
9 388 431 0
10 0 430 0
Refresh

Figure 4-2-34 LLDP Configuration page screenshot

The page includes the following fields:

Object	Description
• **Neighbor Entries List Last Updated**	The time the LLDP neighbor entry list was last updated.
• **New Neighbor Entries Count**	The number of LLDP neighbors for which the remote TTL has not yet expired.
• **Neighbor Entries Deleted Count**	The number of LLDP neighbors which have been removed from the LLDP remote systems MIB for any reason.
• **Neighbor Entries Dropped Count**	The number of times which the local remote database dropped an LLDPDU because of insufficient resources.
• **Neighbor Entries Age-out Count**	The number of times that a neighbor's information has been deleted from the LLDP remote systems MIB because the remote TTL timer has expired.

4.2.12.8 LLDP Device Statistics Details

Use the LLDP Device Statistics Details screen to display detailed statistics for LLDP-capable devices attached to specific interfaces on the Managed Switch.

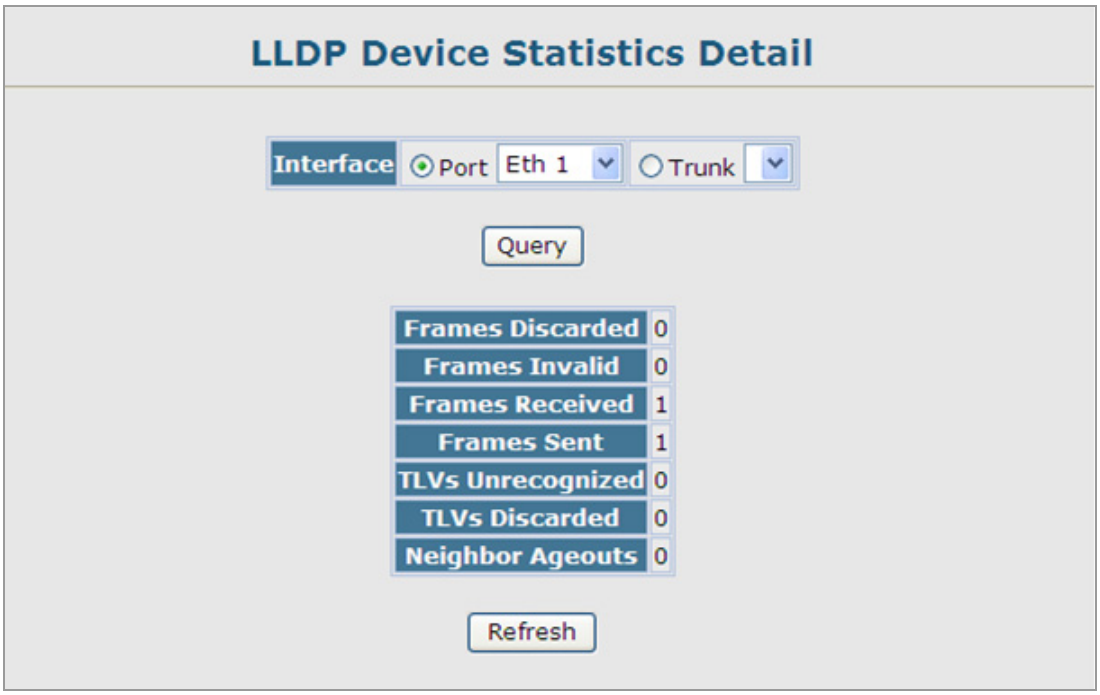


Figure 4-2-35 LLDP Device Statistics Details page screenshot

The page includes the following fields:

Object	Description
• **Frames Discarded**	Number of frames discarded because they did not conform to the general validation rules as well as any specific usage rules defined for the particular TLV.
• **Frames Invalid**	A count of all LLDPDUs received with one or more detectable errors.
• **Frames Received**	Number of LLDP PDUs received.
• **Frames Sent**	Number of LLDP PDUs transmitted.
• **TLVs Unrecognized**	A count of all TLVs not recognized by the receiving LLDP local agent.
• **TLVs Discarded**	A count of all LLDPDUs received and then discarded due to insufficient memory space, missing or out-of-sequence attributes, or any other reason.
• **Neighbor Ageouts**	A count of the times that a neighbor's information has been deleted from the LLDP remote systems MIB because the remote TTL timer has expired.

4.3 Simple Network Management Protocol

Simple Network Management Protocol (SNMP) is a communication protocol designed specifically for managing devices on a network. Equipment commonly managed with SNMP includes switches, routers and host computers. SNMP is typically used to configure these devices for proper operation in a network environment, as well as to monitor them to evaluate performance or detect potential problems.

Managed devices supporting SNMP contain software, which runs locally on the device and is referred to as an agent. A defined set of variables, known as managed objects, is maintained by the SNMP agent and used to manage the device. These objects are defined in a **Management Information Base (MIB)** that provides a standard presentation of the information controlled by the agent. SNMP defines both the format of the MIB specifications and the protocol used to access this information over the network.

The Managed Switch includes an onboard agent that supports SNMP versions 1, 2c, and 3. This agent continuously monitors the status of the Managed Switch hardware, as well as the traffic passing through its ports. A network management station can access this information using software such as HP OpenView. Access to the onboard agent from clients using SNMP v1 and v2c is controlled by community strings. To communicate with the switch, the management station must first submit a valid community string for authentication.

Access to the switch using from clients using SNMPv3 provides additional security features that cover message integrity, authentication, and encryption; as well as controlling user access to specific areas of the MIB tree.

The SNMPv3 security structure consists of security models, with each model having it's own security levels. There are three security models defined, **SNMPv1**, **SNMPv2c**, and **SNMPv3**. Users are assigned to "**groups**" that are defined by a security model and specified security levels. Each group also has a defined security access to set of MIB objects for reading and writing, which are known as "**views**." The switch has a default view (all MIB objects) and default groups defined for security models v1 and v2c. The following table shows the security models and levels available and the system default settings.

Model	Level	Group	Read View	Write View	Notify View	Security
v1	noAuthNoPriv	public (read only)	defaultview	none	none	Community string only
v1	noAuthNoPriv	private(read/write)	defaultview	defaultview	none	Community string only
v1	noAuthNoPriv	user defined	user defined	user defined	user defined	Community string only
v2c	noAuthNoPriv	public (read only)	defaultview	none	none	Community string only
v2c	noAuthNoPriv	private (read/write)	defaultview	defaultview	none	Community string only
v2c	noAuthNoPriv	user defined	user defined	user defined	user defined	Community string only
v3	noAuthNoPriv	user defined	user defined	user defined	user defined	A user name match only
v3	AuthNoPriv	user defined	user defined	user defined	user defined	Provides user authentication via MD5 or SHA algorithms

v3	AuthPriv	user defined	user defined	user defined	user defined	Provides user authentication via MD5 or SHA algorithms and data privacy using DES 56-bit encryption

Note

The predefined default groups and view can be deleted from the system. You can then define customized groups and views for the SNMP clients that require access.

4.3.1 SNMP Agent Status

Enable SNMP service for all management clients. (i.e., versions 1, 2c or 3).

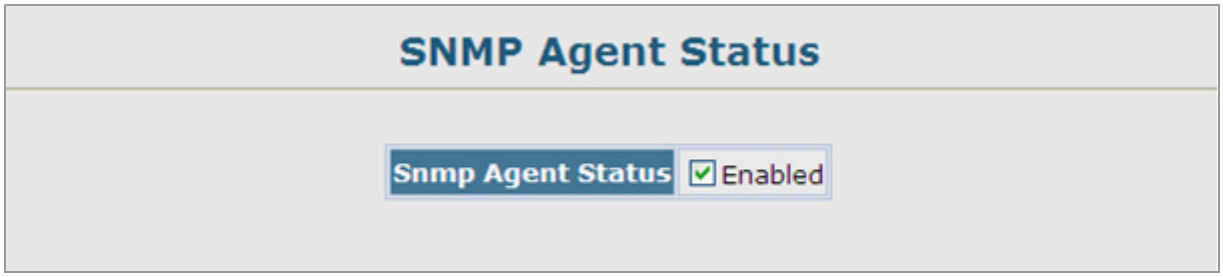


Figure 4-3-1 SNMP Agent Status page screenshot

The page includes the following fields:

Object	Description
• **Snmp Agent Status**	Enable / Disable SNMP on the Managed Switch

4.3.2 SNMP Configuration

Use this page to configure the community strings authorized for management access, and to specify the trap managers that will receive SNMP notifications or trap messages.

4.3.2.1 SNMP Community

All community strings used for IP Trap Managers should be listed in this table. Up to five community strings may be entered. For security reasons, you should consider removing the default strings.

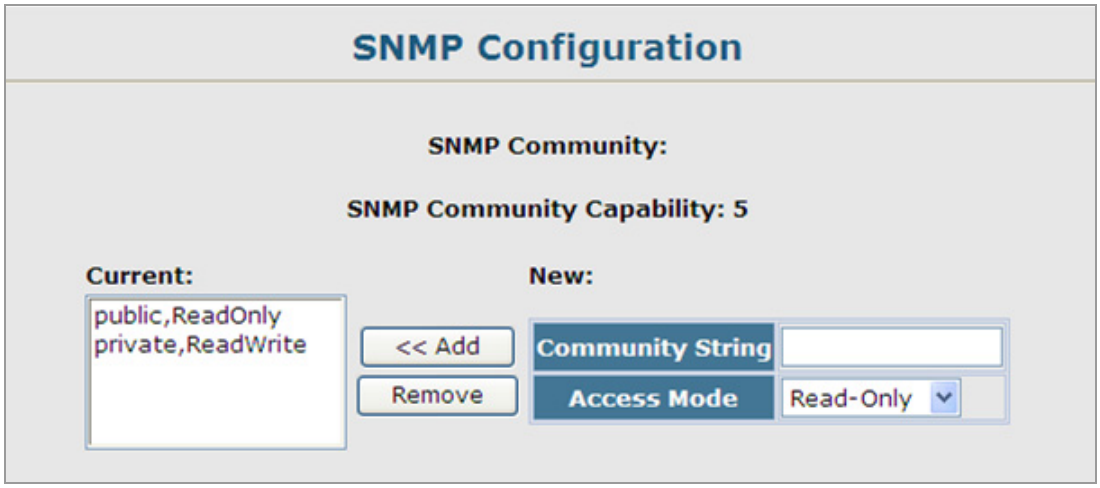


Figure 4-3-2 SNMP Configuration page screenshot

1. Click SNMP, Configuration.
2. Add new community strings as required, select the access rights from the Access Mode drop-down list, then click Add.

The page includes the following fields:

Object	Description
• **SNMP Community Capability**	The switch supports up to five community strings.
• **Community String**	A community string that acts like a password and permits access to the SNMP protocol. Default strings: "**public**" (read-only), "**private**" (read/write) Range: 1-32 characters, case sensitive
• **Access Mode**	Specifies the access rights for the community string: • **Read-Only** – Authorized management stations are only able to retrieve MIB objects. • **Read/Write** – Authorized management stations are able to both retrieve and modify MIB objects.

4.3.2.2 SNMP Trap Management

Traps indicating status changes are issued by the switch to specified trap managers. You must specify trap managers so that key events are reported by this switch to your management station (using network management platforms such as HP OpenView). You can specify up to five management stations that will receive authentication failure messages and other trap messages from the Managed Switch.

- You can enable or disable authentication messages via the Web interface.
- You can enable or disable authentication messages, link-up-down messages, or all notification types via the CLI.

If you specify an **SNMP Version 3** host, then the "Trap Manager Community String" is interpreted as an SNMP user name. If you use V3 authentication or encryption options (authNoPriv or authPriv), the user name must first be defined in the SNMPv3 Users page. Otherwise, the authentication password and/or privacy password will not exist, and the switch will not authorize SNMP access for the host. However, if you specify a V3 host with the no authentication (noAuth) option, an SNMP user account will be automatically generated, and the switch will authorize SNMP access for the host.

Notifications are issued by the switch as trap messages by default. The recipient of a trap message does not send a response to the switch. Traps are therefore not as reliable as inform messages, which include a request for acknowledgement of receipt. Informs can be used to ensure that critical information is received by the host. However, note that informs consume more system resources because they must be kept in memory until a response is received. Informs also add to network traffic. You should consider these effects when deciding whether to issue notifications as traps or informs.

To send an inform to a SNMPv2c host, complete these steps:

1. Enable the SNMP agent.
2. Enable trap informs as described in the following pages.
3. Create a view with the required notification messages.
4. Create a group that includes the required notify view.

To send an inform to a SNMPv3 host, complete these steps:

1. Enable the SNMP agent.
2. Enable trap informs as described in the following pages.
3. Create a view with the required notification messages.
4. Create a group that includes the required notify view.
5. Specify a remote engine ID where the user resides.
6. Then configure a remote user.

Figure 4-3-3 SNMP Trap Management page screenshot

1. Click SNMP, Configuration.
2. Enter the IP address and community string for each management station that will receive trap messages, specify the UDP port, trap version, trap security level (for v3 clients), trap inform settings (for v2c/v3 clients), and then click Add.
3. Select the trap types required using the check boxes for Authentication and Link-up/down traps, and then click Apply.

The page includes the following fields:

Object	Description
• **Trap Manager Capability**	This switch supports up to five trap managers.
• **Current**	Displays a list of the trap managers currently configured.
• **Trap Manager IP Address**	IP address of a new management station to receive notification message (i.e., the targeted recipient).
• **Trap Manager Community String**	Specifies a valid community string for the new trap manager entry. Though you can set this string in the Trap Managers table, we recommend that you define this string in the SNMP Configuration page (for Version 1 or 2c clients), or define a corresponding "User Name" in the SNMPv3 Users page (for Version 3 clients). (Range: 1-32 characters, case sensitive)
• **Trap UDP Port**	Specifies the UDP port number used by the trap manager. (Default: **162**)
• **Trap Version**	Specifies whether to send notifications as SNMP v1, v2c, or v3 traps. (Default: **v1**)
• **Trap Security Level**	When trap version 3 is selected, you must specify one of the following security levels. • **noAuthNoPriv** There is no authentication or encryption used in SNMP communications. • **AuthNoPriv** SNMP communications use authentication, but the data is not encrypted (only available for the SNMPv3 security model). • **AuthPriv** SNMP communications use both authentication and encryption (only available for the SNMPv3 security model). (Default: **noAuthNoPriv**)
• **Trap Inform**	Notifications are sent as inform messages. Note that this option is only available for version 2c and 3 hosts. (Default: traps are used) **Timeout** The number of seconds to wait for an acknowledgment before resending an inform message. Range: 0-2147483647 cent seconds; Default: **1500** cent seconds **Retry times** –receipt. The maximum number of times to resend an inform message if the recipient does not acknowledge. Range: 0-255; Default: **3**
• **Enable Authentication**	Issues a notification message to specified IP trap managers whenever an invalid

Traps	community string is submitted during the SNMP access authentication process. (Default: **Enabled**)
• **Enable Link-up and Link-down Traps**	Issues a notification message whenever a port link is established or broken. (Default: **Enabled**)

These are legacy notifications and therefore when used for SNMP Version 3 hosts, they must be enabled in conjunction with the corresponding entries in the Notification View

4.3.3 SNMPv3

Configuring SNMPv3 Management Access

To configure SNMPv3 management access to the switch, follow these steps:

1. If you want to change the default engine ID, it must be changed first before configuring other parameters.
2. Specify read and write access views for the switch MIB tree.
3. Configure SNMP user groups with the required security model (i.e., SNMP v1, v2c or v3) and security level (i.e., authentication and privacy).
4. Assign SNMP users to groups, along with their specific authentication and privacy passwords.

4.3.3.1 SNMPv3 Engine ID

A SNMPv3 engine is an independent SNMP agent that resides on the switch. This engine protects against message replay, delay, and redirection. The engine ID is also used in combination with user passwords to generate the security keys for authenticating and encrypting SNMPv3 packets.

A local engine ID is **automatically generated** that is unique to the switch. This is referred to as the default engine ID. If the local engine ID is deleted or changed, all SNMP users will be cleared. You will need to reconfigure all existing users.

A new engine ID can be specified by entering 10 to 64 hexadecimal characters. If an odd number of characters are specified, the last character is dropped. For example, entering the value "12345678901" sets the engine ID as "1234567890".

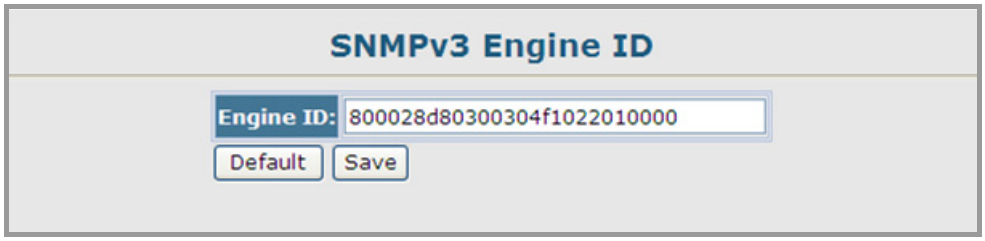


Figure 4-3-4 SNMPv3 Engine ID page screenshot

The page includes the following fields:

Object	Description
• **Engine ID**	A SNMPv3 engine is an independent SNMP agent that resides on the Managed Switch
• **Default**	Sets the default
• **Save**	Saves the setting

4.3.3.2 SNMPv3 Remote Engine ID

To send inform messages to a SNMPv3 user on a remote device, you must first specify the engine identifier for the SNMP agent on the remote device where the user resides. The remote engine ID is used to compute the security digest for authenticating and encrypting packets sent to a user on the remote host.

SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

(See "**Specifying Trap Managers and Trap Types**" and "**Configuring Remote SNMPv3 Users**".)

A new engine ID can be specified by entering 10 to 64 hexadecimal characters. If an odd number of characters are specified, the last character is dropped. For example, entering the value "12345678901" sets the engine ID as "1234567890".

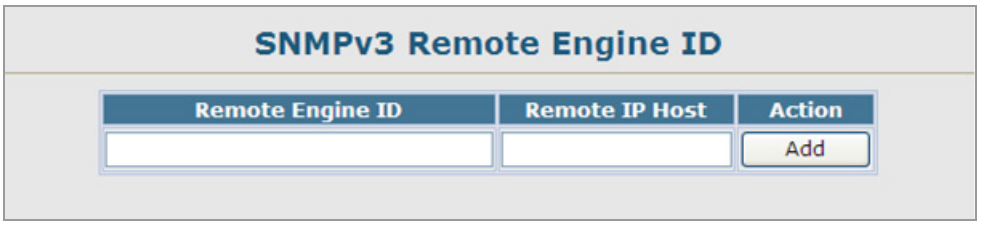


Figure 4-3-5 SNMPv3 Remote Engine ID page screenshot

The page includes the following fields:

Object	Description
• **Remote Engine ID**	Specifies the Remote Engine ID (5-32 octets)
• **Remote IP Host**	Specifies the IP address of the Remote IP Host.

4.3.3.3 SNMPv3 Users

Each SNMPv3 user is defined by a unique name. Users must be configured with a specific security level and assigned to a group. The SNMPv3 group restricts users to a specific read, write, and notify view.

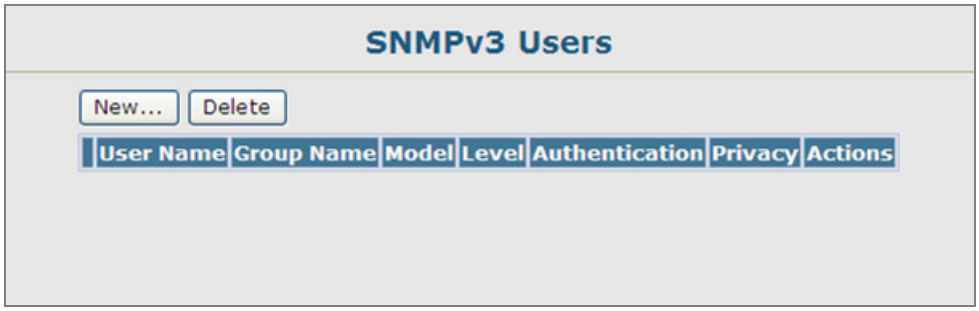


Figure 4-3-6 SNMPv3 Users page screenshot

The page includes the following fields:

Object	Description
• **User Name**	The name of user connecting to the SNMP agent. (Range: 1-32 characters)
• **Group Name**	The name of the SNMP group to which the user is assigned. (Range: 1-32 characters)
• **Model**	The user security model; SNMP v1, v2c or v3.
• **Level**	The security level used for the user: -**noAuthNoPriv** There is no authentication or encryption used in SNMP communications. (This is the default for SNMPv3.) -**AuthNoPriv** SNMP communications use authentication, but the data is not encrypted (only available for the SNMPv3 security model). -**AuthPriv** SNMP communications use both authentication and encryption (only available for the SNMPv3 security model).
• **Authentication**	The method used for user authentication. Options: **MD5, SHA** Default: **MD5**
• **Authentication Password**	A minimum of eight plain text characters is required.
• **Privacy Protocol**	The encryption algorithm use for data privacy; only 56-bit DES is currently available.
• **Privacy Password**	A minimum of eight plain text characters is required.
• **Actions**	Enables the user to be assigned to another SNMPv3 group.

■ Add / Remote SNMPv3 new users

1. Click SNMP, SNMPv3, Users.
2. Click **New** to configure a user name.
3. In the New User page, define a name and assign it to a group, then click **Add** to save the configuration and return to the User Name list.
4. To delete a user, check the box next to the user name, then click Delete.
5. To change the assigned group of a user, click **Change Group** in the Actions column of the users table and select the new group.

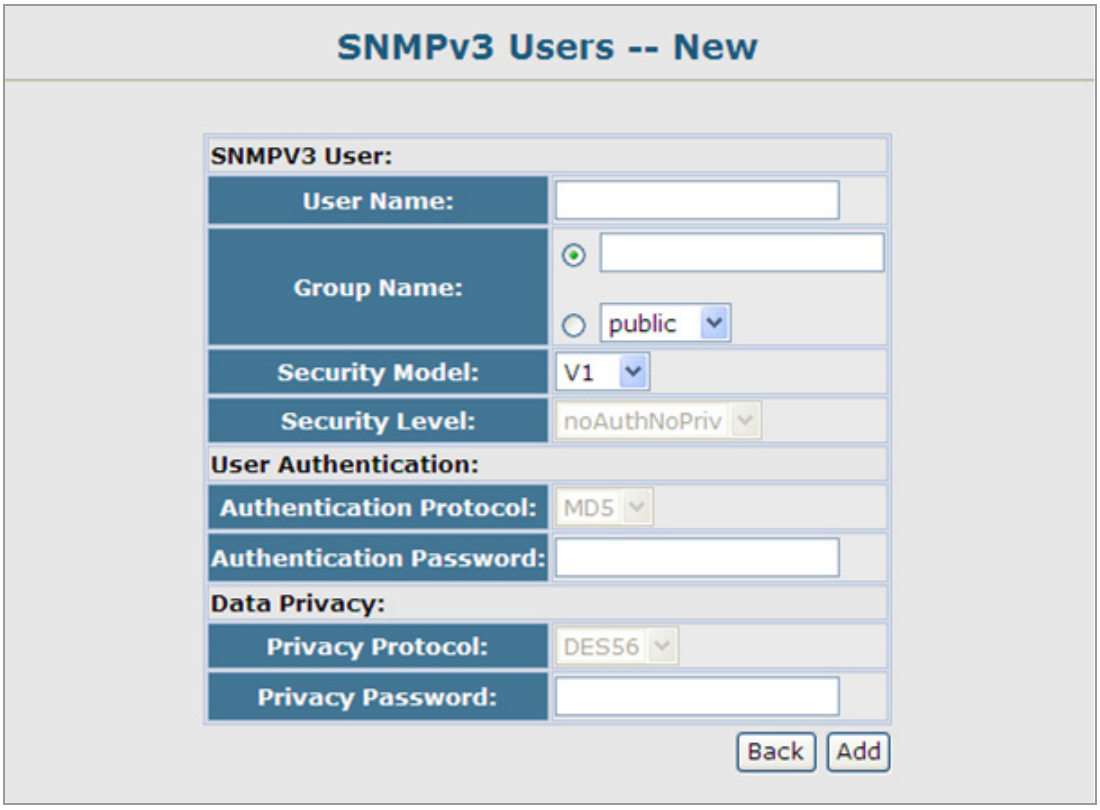


Figure 4-3-7 SNMPv3 Users-NEW page screenshot

The "**SNMPv3 User – New**" page includes the following fields:

Object	Description
• **User Name**	The name of user connecting to the SNMP agent. (Range: 1-32 characters)
• **Group Name**	The name of the SNMP group to which the user is assigned. (Range: 1-32 characters)
• **Security Model**	The user security model; SNMP v1, v2c or v3.
• **Security Level**	The security level used for the user: -**noAuthNoPriv** There is no authentication or encryption used in SNMP communications.

		(This is the default for SNMPv3.)
	-**AuthNoPriv**	SNMP communications use authentication, but the data is not encrypted (only available for the SNMPv3 security model).
	-**AuthPriv**	SNMP communications use both authentication and encryption (only available for the SNMPv3 security model).
• **Authentication Protocol**	The method used for user authentication. Options: **MD5**, **SHA**; Default: **MD5**	
• **Authentication Password**	A minimum of eight plain text characters is required.	
• **Privacy Protocol**	The encryption algorithm use for data privacy; only 56-bit DES is currently available.	
• **Privacy Password**	A minimum of eight plain text characters is required.	

■ **EXAMPLE: Add a new SNMPv3 user**

In the New User page, define a name and assign it to a group, then click **Add** to save the configuration and return to the User Name list.

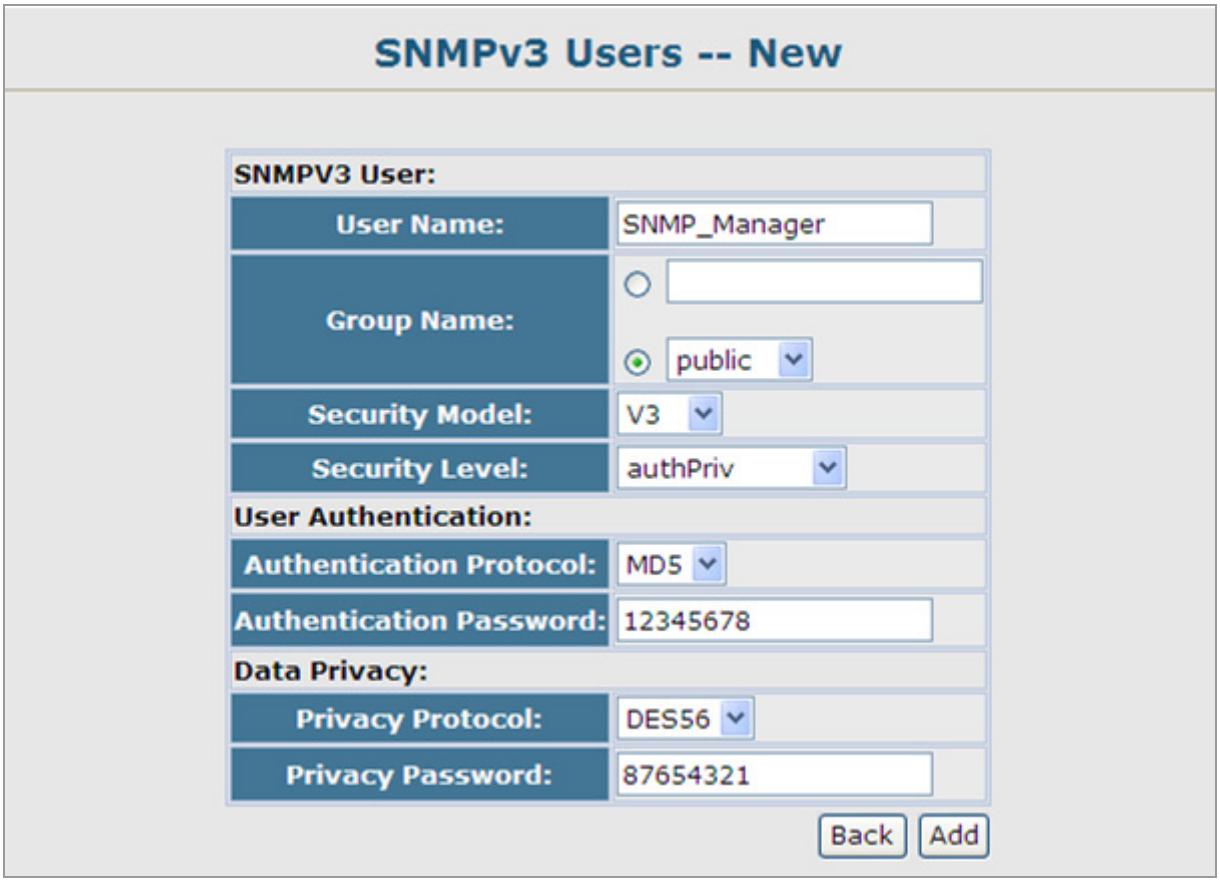


Figure 4-3-8 SNMPv3 Users-NEW page screenshot

Once the new SNMPv3 user be successed add and be assign to a snmp group, this entry will shows in the users table.

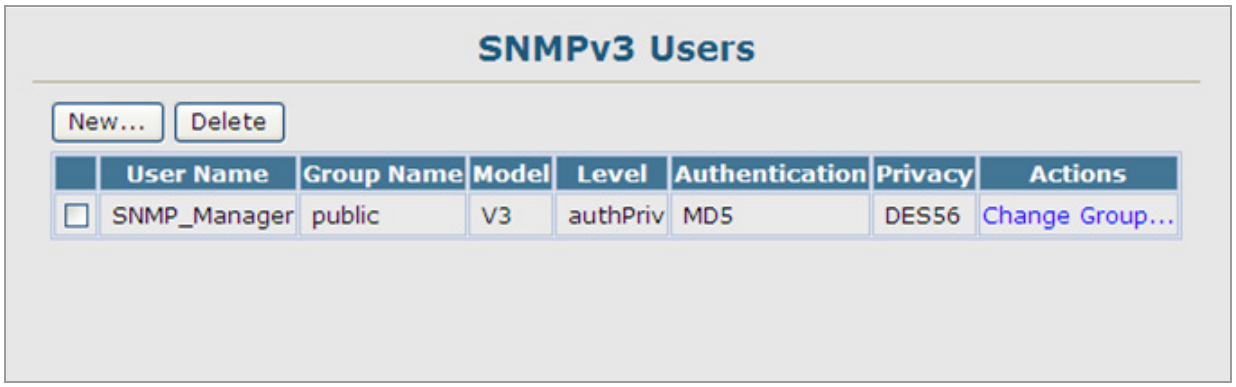


Figure 4-3-9 SNMPv3 Users page screenshot

4.3.3.4 SNMPv3 Remote Users

Each SNMPv3 user is defined by a unique name. Users must be configured with a specific security level and assigned to a group. The SNMPv3 group restricts users to a specific read, write, and notify view.

To send inform messages to a SNMPv3 user on a remote device, you must first specify the engine identifier for the SNMP agent on the remote device where the user resides. The remote engine ID is used to compute the security digest for authenticating and encrypting packets sent to a user on the remote host. (See "**Specifying Trap Managers and Trap Types**" and "**Specifying a Remote Engine ID**".)

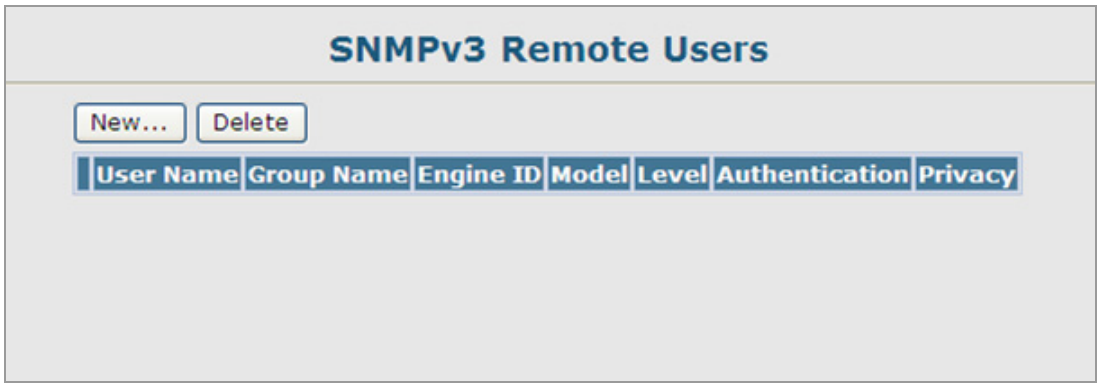


Figure 4-3-10 SNMPv3 Remote Users page screenshot

1. Click SNMP, SNMPv3, Remote Users.
2. Click New to configure a user name.
3. In the New User page, define a name and assign it to a group, then click Add to save the configuration and return to the User Name list.
4. To delete a user, check the box next to the user name, then click Delete.

The page includes the following fields:

Object	Description
• **User Name**	The name of user connecting to the SNMP agent. (Range: 1-32 characters)
• **Group Name**	The name of the SNMP group to which the user is assigned. (Range: 1-32 characters)
• **Model**	The user security model; SNMP v1, v2c or v3.
• **Level**	The security level used for the user: -**noAuthNoPriv** There is no authentication or encryption used in SNMP communications. (This is the default for SNMPv3.) -**AuthNoPriv** SNMP communications use authentication, but the data is not encrypted (only available for the SNMPv3 security model). -**AuthPriv** SNMP communications use both authentication and encryption (only available for the SNMPv3 security model).
• **Authentication**	The method used for user authentication. Options: **MD5**, **SHA**; Default: **MD5**
• **Authentication Password**	A minimum of eight plain text characters is required.
• **Privacy Protocol**	The encryption algorithm use for data privacy; only 56-bit DES is currently available.
• **Privacy Password**	A minimum of eight plain text characters is required.
• **Actions**	Enables the user to be assigned to another SNMPv3 group.

4.3.3.5 SNMPv3 Groups

A SNMPv3 group sets the access policy for its assigned users, restricting them to specific read, write, and notify views. You can use the pre-defined default groups or create new groups to map a set of SNMP users to SNMP views.

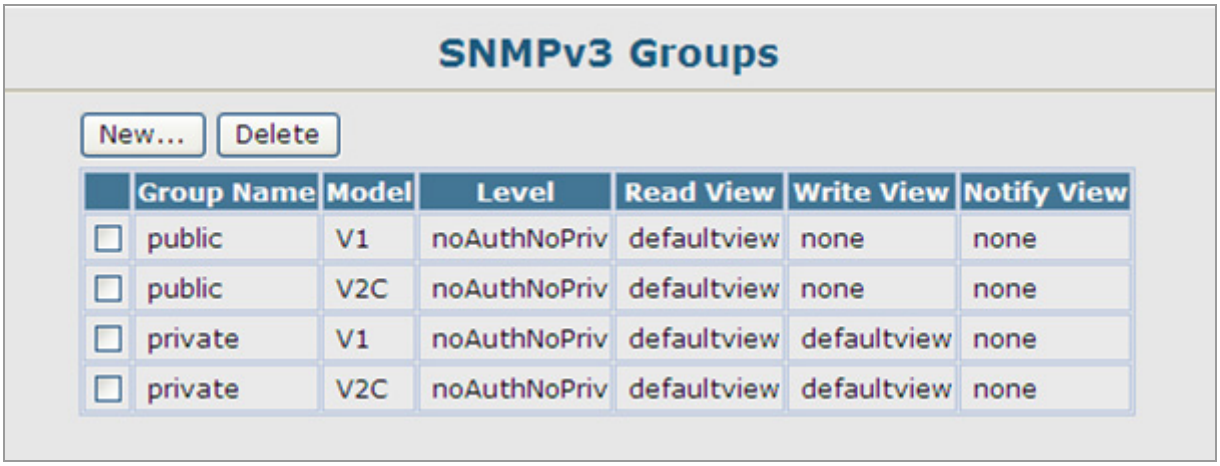


Figure 4-3-11 SNMPv3 Groups page screenshot

1. Click SNMP, SNMPv3, **Groups**.
2. Click **New** to configure a new group.
3. In the **New Group page**, define a name, assign a security model and level, and then select read and write views.
4. Click Add to save the new group and return to the Groups list.
5. To delete a group, check the box next to the group name, then click Delete.

The page includes the following fields:

Object	Description
• **Group Name**	The name of the SNMP group to which the user is assigned. (Range: 1-32 characters)
• **Model**	The user security model; SNMP v1, v2c or v3.
• **Level**	The security level used for the user: -**noAuthNoPriv** There is no authentication or encryption used in SNMP communications. (This is the default for SNMPv3.) -**AuthNoPriv** SNMP communications use authentication, but the data is not encrypted (only available for the SNMPv3 security model). -**AuthPriv** SNMP communications use both authentication and encryption (only available for the SNMPv3 security model).
• **Read View**	The configured view for read access. (Range: 1-64 characters)
• **Write View**	The configured view for write access. (Range: 1-64 characters)

• **Notify View**	The configured view for notifications. (Range: 1-64 characters)

■ EXAMPLE: Add a new SNMPv3 Group

In the **New Group page**, define a name, assign a security model and level, and then select read and write views. Click Add to save the new group and return to the Groups list.

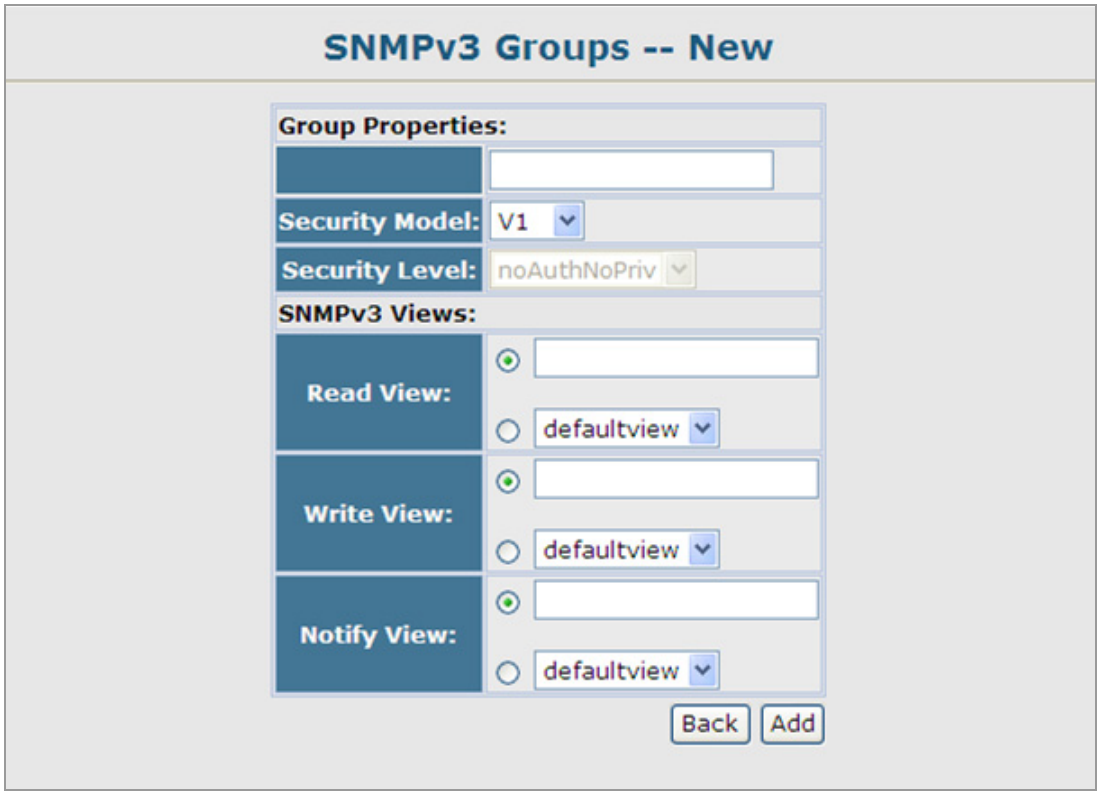


Figure 4-3-12 SNMPv3 Groups-NEW page screenshot

Object Label	Object ID	Description
RFC 1493 Traps		
newRoot	1.3.6.1.2.1.17.0.1	The newRoot trap indicates that the sendingagent has become the new root of the Spanning Tree; the trap is sent by a bridge soon after its election as the new root, e.g., upon expiration of the Topology Change Timer immediatelysubsequent to its election.
topologyChange	1.3.6.1.2.1.17.0.2	A topologyChange trap is sent by a bridge when any of its configured ports transitions from the Learning state to the Forwarding state, or from the Forwarding state to the Discarding state.The trap is not sent if a newRoot trap is sent for the same transition.
SNMPv2 Traps		

coldStart	1.3.6.1.6.3.1.1.5.1	A coldStart trap signifies that the SNMPv2 entity, acting in an agent role, is reinitializing itself and that its configuration may have been altered.
warmStart	1.3.6.1.6.3.1.1.5.2	A warmStart trap signifies that the SNMPv2 entity, acting in an agent role, is reinitializingitself such that its configuration is unaltered.
linkDown*	1.3.6.1.6.3.1.1.5.3	A linkDown trap signifies that the SNMP entity,acting in an agent role, has detected that the ifOperStatus object for one of its communication links is about to enter the down state from some other state (but not from thenotPresent state). This other state is indicated by the included value of ifOperStatus.
linkUp*	1.3.6.1.6.3.1.1.5.4	A linkUp trap signifies that the SNMP entity, acting in an agent role, has detected that the ifOperStatus object for one of its communication links left the down state and transitioned into some other state (but not into the notPresent state). This other state is indicated by the included value of ifOperStatus.
authenticationFailure*	1.3.6.1.6.3.1.1.5.5	An authenticationFailure trap signifies that the SNMPv2 entity, acting in an agent role, has received a protocol message that is not properly authenticated. While all implementations of the SNMPv2 must becapable of generating this trap, the snmpEnableAuthenTraps object indicates whether this trap will be generated.
RMON Events (V2)		
risingAlarm	1.3.6.1.2.1.16.0.1	The SNMP trap that is generated when an alarm entry crosses its rising threshold and generates an event that is configured for sending SNMP traps.
fallingAlarm	1.3.6.1.2.1.16.0.2	The SNMP trap that is generated when an alarm entry crosses its falling threshold and generates an event that is configured for sending SNMP traps.
Private Traps		
swPowerStatus ChangeTrap	1.3.6.1.4.1.259.6.10.103.2 .1.0.1	This trap is sent when the power state changes.
swIpFilterRejectTrap	1.3.6.1.4.1.259.6.10.103.2 .1.0.40	This trap is sent when an incorrect IP address isrejected by the IP Filter.

Table 4-3-1 Supported Notification Messages

4.3.3.6 SNMPv3 View

SNMPv3 views are used to restrict user access to specified portions of the MIB tree. The predefined view "defaultview" includes access to the entire MIB tree.

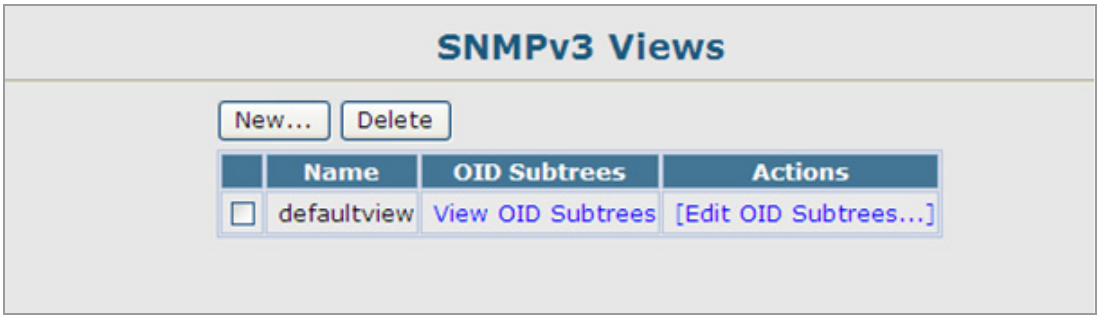


Figure 4-3-13 SNMPv3 Views page screenshot

The page includes the following fields:

Object	Description
• **View Name**	The name of the SNMP view. (Range: 1-64 characters)
• **View OID Subtrees**	Shows the currently configured object identifiers of branches within the MIB tree that define the SNMP view.
• **Edit OID Subtrees**	Allows you to configure the object identifiers of branches within the MIB tree. Wild cards can be used to mask a specific portion of the OID string.
• **Type**	Indicates if the object identifier of a branch within the MIB tree is included or excluded from the SNMP view.

1. Click SNMP, SNMPv3, Views.
2. Click **New** to configure a new view.
3. In the **New View** page, define a name and specify OID subtrees in the switch MIB to be included or excluded in the view.
4. Click Back to save the new view and return to the SNMPv3 Views list.
5. For a specific view, click on **View OID Subtrees** to display the current configuration, or click on **Edit OID Subtrees** to make changes to the view settings.
6. To delete a view, check the box next to the view name, then click Delete.

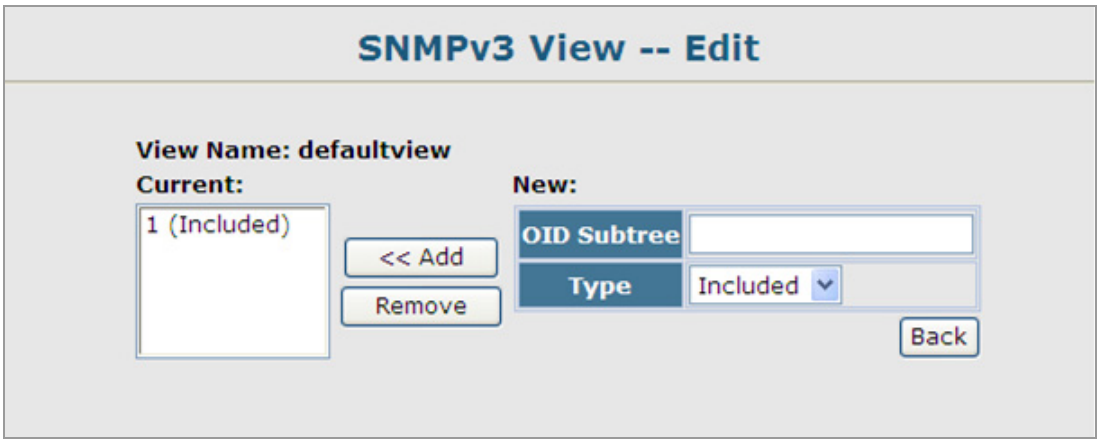


Figure 4-3-14 SNMPv3 View-Edit page screenshot

4.4 Port Management

Use the Port Menu to display or configure the Managed Switch's ports. This section has the following items:

- **Port Information** Displays port connection status
- **Port Configuration** Configures port connection settings
- **Port Broadcast Control** Sets the broadcast storm threshold for each port
- **Mirror Port Configuration** Sets the source and target ports for mirroring
- **Rate Limit**
- **Input Port Configuration** Sets the input rate limit for each port
- **Output Port Configuration** Sets the output rate limit for ports
- **Port Statistics** Lists Ethernet and RMON port statistics

4.4.1 Port Information

You can use the Port Information or Trunk Information pages to display the current connection status, including link state, speed/duplex mode, flow control, and auto-negotiation. To change any of the port settings, use the Port Configuration or Trunk Configuration page.

Port Information

Port	Name	Type	Admin Status	Oper Status	Speed Duplex Status	Flow Control Status	Autonegotiation	Trunk Member
1		100Base-TX	Enabled	Down	100full	None	Enabled	
2		100Base-TX	Enabled	Down	100full	None	Enabled	
3		100Base-TX	Enabled	Down	100full	None	Enabled	
4		100Base-TX	Enabled	Down	100full	None	Enabled	
5		100Base-TX	Enabled	Down	100full	None	Enabled	
6		100Base-TX	Enabled	Down	100full	None	Enabled	
7		100Base-TX	Enabled	Down	100full	None	Enabled	
8		100Base-TX	Enabled	Down	100full	None	Enabled	
9		1000Base-TX	Enabled	Up	100full	None	Enabled	
10		1000Base-TX	Enabled	Down	1000full	None	Enabled	

Figure 4-4-1 Port Information page screenshot

The page includes the following fields:

Object	Description
• **Name**	Interface label.
• **Type**	Indicates the port type. The possible type such as: - **100BASE-TX** - **1000BASE-T** - **1000BASE-SFP**
• **Admin Status**	Shows if the interface is enabled or disabled.
• **Oper Status**	Indicates if the link is Up or Down.
• **Speed Duplex Status**	Shows the current speed and duplex mode. (Auto, or fixed choice)
• **Flow Control Status**	Indicates the type of flow control currently in use. - **IEEE 802.3x** - **Back-Pressure** - **None**
• **Autonegotiation**	Shows if auto-negotiation is enabled or disabled.
• **Trunk Member**	Shows if port is a trunk member.
• **Creation**	Shows if a trunk is manually configured or dynamically set via LACP. (Trunk Information only.)

In some situation, when the Managed Switch port is set to "**Auto-negotiation**" mode and the link partner (ex. PC or another switch) is force set to "**100Full**", the speed duplex status shows "**100Half**" since the Managed Switch is fail to negotiation with the link partner.

4.4.2 Port Configuration

You can use the Port Configuration page to enable/disable an interface, set auto-negotiation and the interface capabilities to advertise, or manually fix the speed, duplex mode, and flow control.

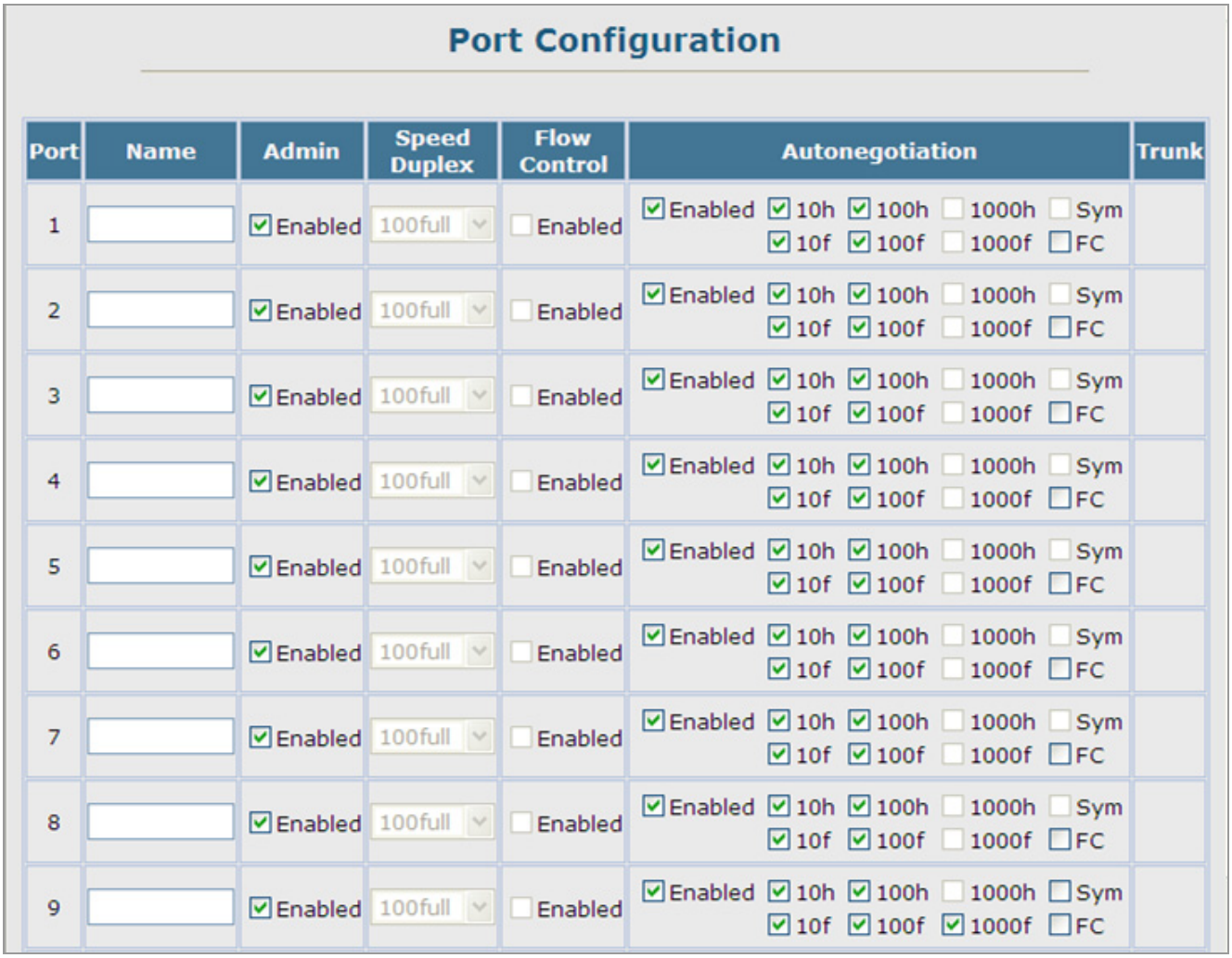

Port Configuration
Port
Name
Admin
Speed Duplex
Flow Control
Autonegotiation
Trunk
1 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
2 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
3 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
4 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
5 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
6 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
7 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
8 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC
9 Enabled 100full Enabled Enabled 10h 100h 1000h Sym 10f 100f 1000f FC

Figure 4-4-2 Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Name**	Allows you to label an interface. (Range: 1-64 characters)
• **Admin**	Allows you to manually disable an interface. You can disable an interface due to abnormal behavior (e.g., excessive collisions), and then re-enable it after the problem has been resolved. You may also disable an interface for security reasons.
• **Speed/Duplex**	Allows you to manually set the port speed and duplex mode. (i.e., with

	auto-negotiation disabled)
• **Flow Control**	Allows automatic or manual selection of flow control (that is, with auto-negotiation disabled). Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, backpressure is used for half-duplex operation and IEEE 802.3-2005 (formally EEE 802.3x) for full-duplex operation. Avoid using flow control on a port connected to a hub unless it is actually required o solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.
• **Autonegotiation**	Allows auto-negotiation to be enabled/ disabled. When auto-negotiation is enabled, you need to specify the capabilities to be advertised. When auto-negotiation is disabled, you can force the settings for speed, mode, and flow control. The following capabilities are supported. **-10half** -Supports 10 Mbps half-duplex operation -**10full** -Supports 10 Mbps full-duplex operation -**100half** - Supports 100 Mbps half-duplex operation -**100full** - Supports 100 Mbps full-duplex operation -**1000full** (Combo ports only) -Supports 1000 Mbps full-duplex operation Default: **Autonegotiation enabled**; Advertised capabilities for 100BASE-TX – 10half, 10full, 100half, 100full; 1000BASE-T – 10half, 10full, 100half, 100full, 1000full; 1000BASE-SX/LX/LH – 1000full
• **Sym**	Check this item to transmit and receive pause frames, or clear it to auto-negotiate the sender and receiver for asymmetric pause frames (for Gigabit Ethernet ports). (The current switch chip only supports symmetric pause frames.)
• **FC**	Supports flow control Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3x for full-duplex operation. (Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.)
• **Trunk**	Indicates if a port is a member of a trunk. To create trunks and select port members, see "**Creating Trunk Groups**".

Note

Check the Link mode of the SFP port if the link failed. To co-works with some fiber-NICs or Gigabit Media Converters, set the Link mode to "1000 Force" is needed.

4.4.3 Port Broadcast Control

Broadcast storms may occur when a device on your network is malfunctioning, or if application programs are not well designed or properly configured. If there is too much broadcast traffic on your network, performance can be severely degraded or everything can come to complete halt.

You can protect your network from broadcast storms by setting a threshold for broadcast traffic for each port. Any broadcast packets exceeding the specified threshold will then be dropped.

Command Usage

- Broadcast Control is enabled by default.
- The default threshold is 1000K packets per second.
- Broadcast control does not effect IP multicast traffic.
- The specified threshold applies to each individual port on the Managed Switch.

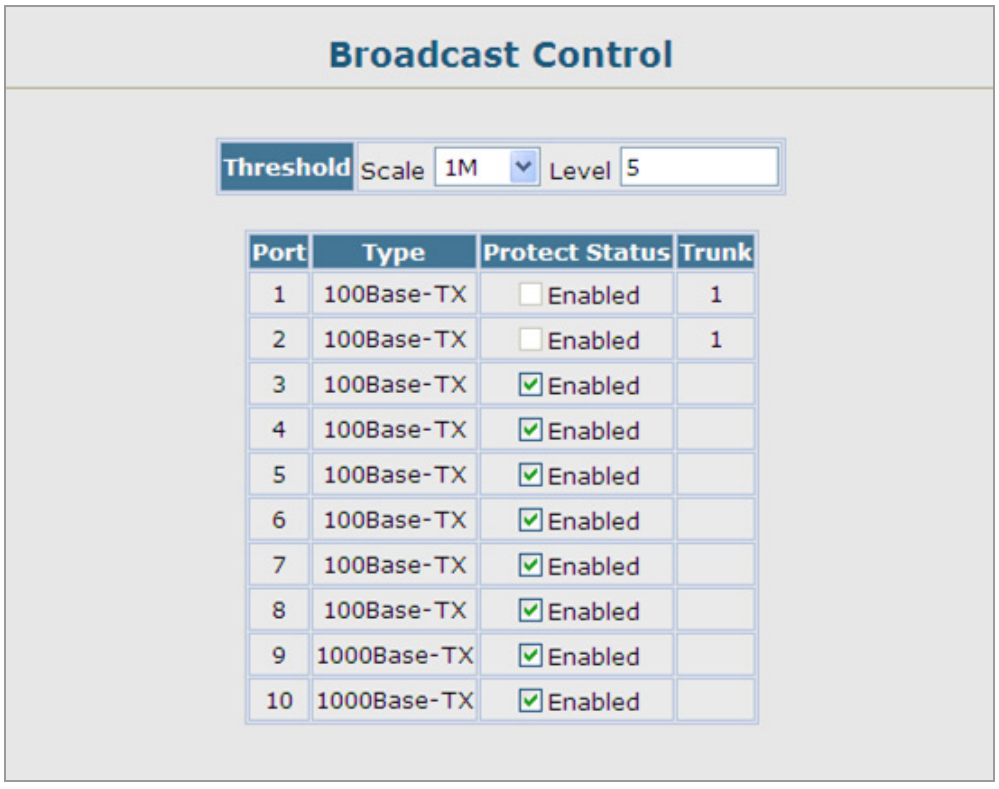


Figure 4-4-3 Broadcast Control page screenshot

1. Click Port, Port/Trunk Broadcast Control.
2. Set the threshold, mark the Enabled field for the desired interface and click Apply.

The page includes the following fields:

Object	Description
• **Threshold**	Multiplied by one another, the scale and level set the broadcast threshold. For example, to set a threshold of 500 Kbytes per second, choose 100K under Scale and 5 under Level. Scale Range: 1, 10, 100, 1000 Kbytes per second; Default: **1000 Kbytes** per second. Level Range: 1-127; Default: **5**
• **Port**	Port number.
• **Trunk**	Shows if a port is a trunk member.
• **Type**	Indicates the port type. (100BASE-TX, 1000BASE-T, or 1000BASE-SFP)
• **Protect Status**	Enables or disables broadcast storm control. Default: **Enabled**
• **Trunk**	Shows if port is a trunk member.

Threshold = Scale x Level

4.4.4 Port Mirroring

The Managed Switch can unobtrusively mirror traffic from any port to a monitor port. You can then attach a protocol analyzer or RMON probe to this port to perform traffic analysis and verify connection integrity.

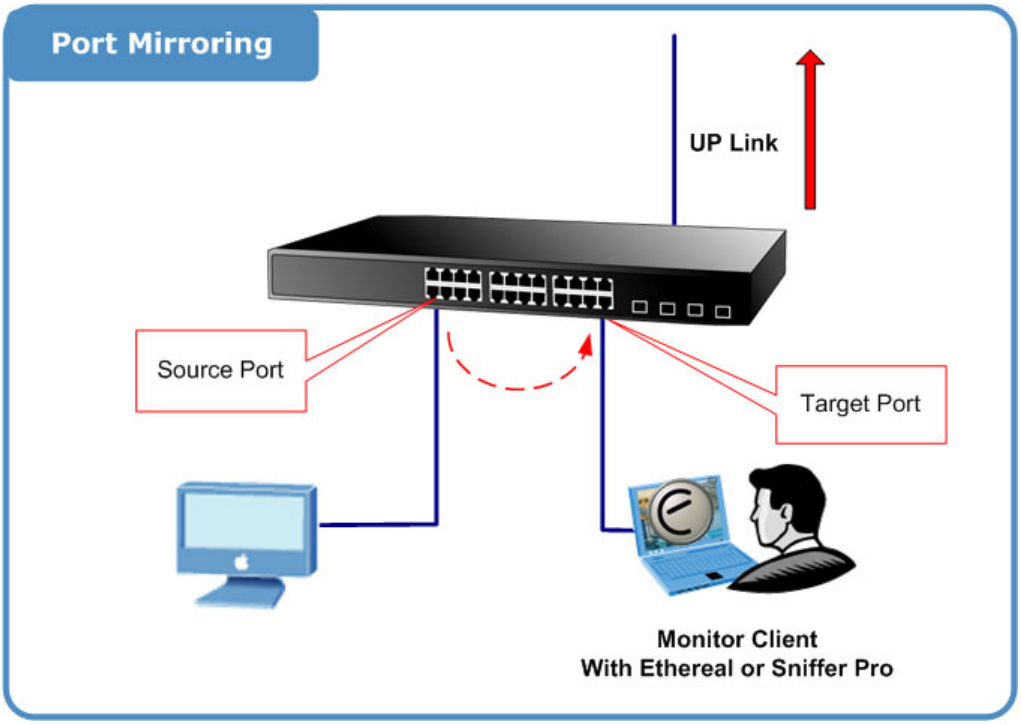


Figure 4-4-4 Port Mirror application

4.4.4.1 Mirror Port Configuration

You can mirror traffic from any source port to a target port for real-time analysis. You can then attach a logic analyzer or RMON probe to the target port and study the traffic crossing the source port in a completely unobtrusive manner.

Command Usage

- Monitor port speed should match or exceed source port speed, otherwise traffic may be dropped from the monitor port.
- All mirror sessions must share the same destination port.

1. Click Port, **Mirror Port Configuration**.
2. Specify the **source port**, the traffic type to be mirrored
3. Specify the **monitor target port**, then click Add.

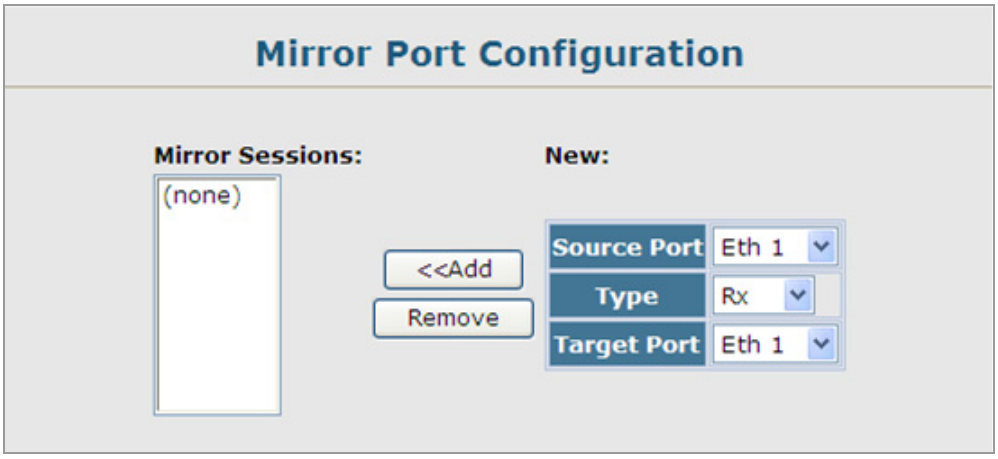


Figure 4-4-5 Mirror Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Mirror Sessions**	Displays a list of current mirror sessions.
• **Source Port**	The port whose traffic will be monitored. Range- SGSW-2840 / SGSW-2840P: 1-28 Range- SGSD-1022 / SGSD-1022P: 1-10
• **Type**	Allows you to select which traffic to mirror to the target port: • **Rx** (receive) • **Tx** (transmit) • **Both** (receive and transmit) (Default: **Rx**)
• **Target Port**	The port that will mirror the traffic on the source port. Range- SGSW-2840 / SGSW-2840P: 1-28 Range- SGSD-1022 / SGSD-1022P: 1-10

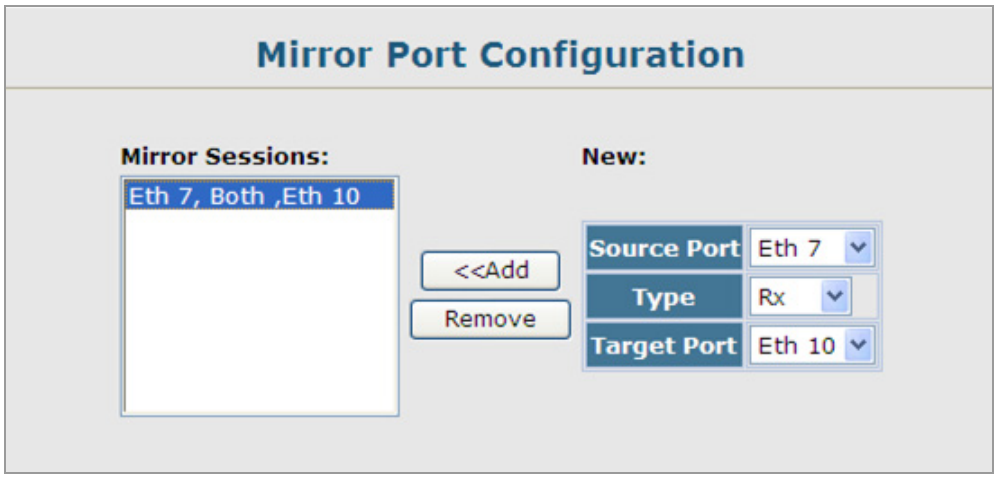


Figure 4-4-6 Mirror Port Configuration page screenshot

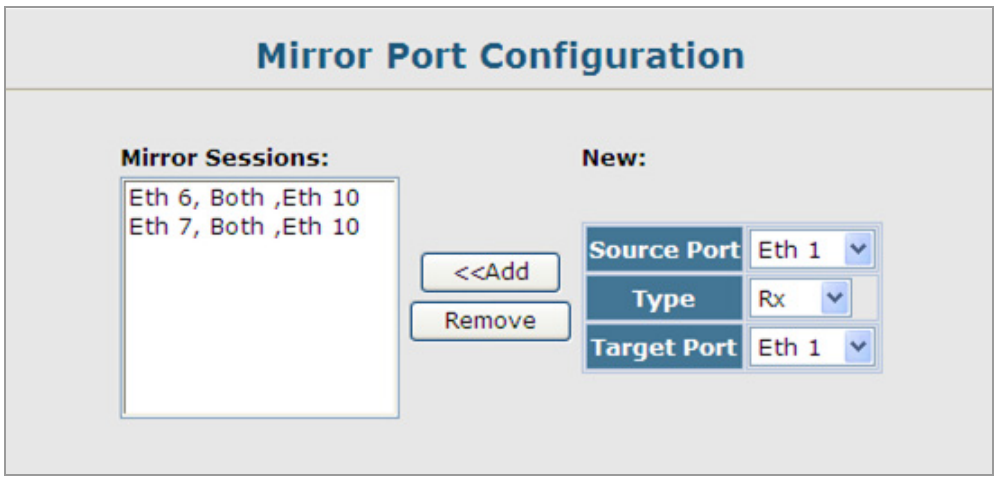


Figure 4-4-7 Mirror Port Configuration page screenshot

4.4.5 Rate Limit

This function allows the network manager to control the maximum rate for traffic received on a port or transmitted from a port. Rate limiting is configured on ports at the edge of a network to limit traffic coming in and out of the network. Packets that exceed the acceptable amount of traffic are dropped.

Rate limiting can be applied to individual ports. When an interface is configured with this feature, the traffic rate will be monitored by the hardware to verify conformity. Non-conforming traffic is dropped, conforming traffic is forwarded without any changes.

4.4.5.1 Input Rate Limit Port Configuration

Use the rate limit configuration pages to apply input rate limiting.

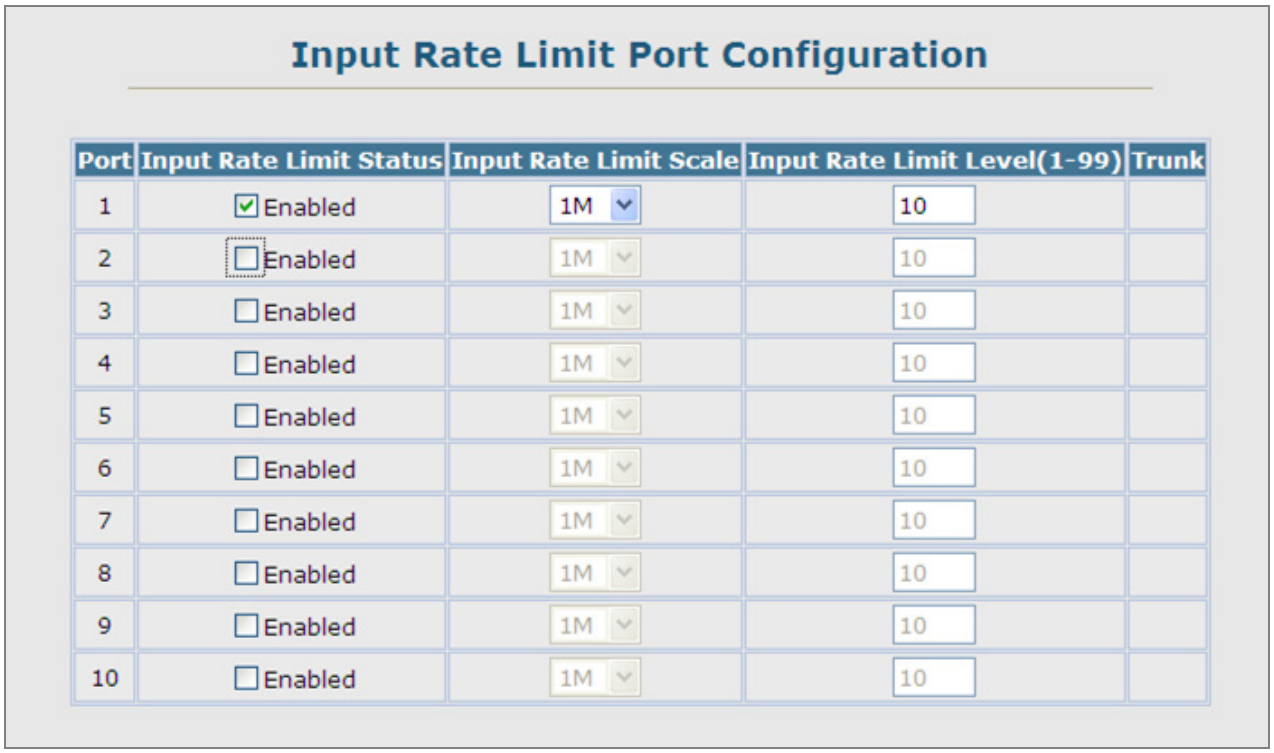


Figure 4-4-8 Input Rate Limit Port Configuration page screenshot

1. Click Port, Rate Limit, Inputt Port Configuration.
2. Enable the Rate Limit Status for the required interfaces, set the Rate Limit Scale and Rate Limit Level, and click Apply.

The page includes the following fields:

Object	Description
• **Port/Trunk**	Displays the port/trunk number
• **Input Rate Limit Status**	Enables or disables the rate limit. (Default: **Enabled**)
• **Input Rate Limit Scale/Level**	Multiplied by one another, the scale and level set the rate limit. For example, to limit port traffic to 500K bytes per second, choose 100K under

Rate Limit Scale and 5 under Rate Limit Level.

4.4.5.2 Output Rate Limit Port Configuration

Use the rate limit configuration pages to apply output rate limiting.

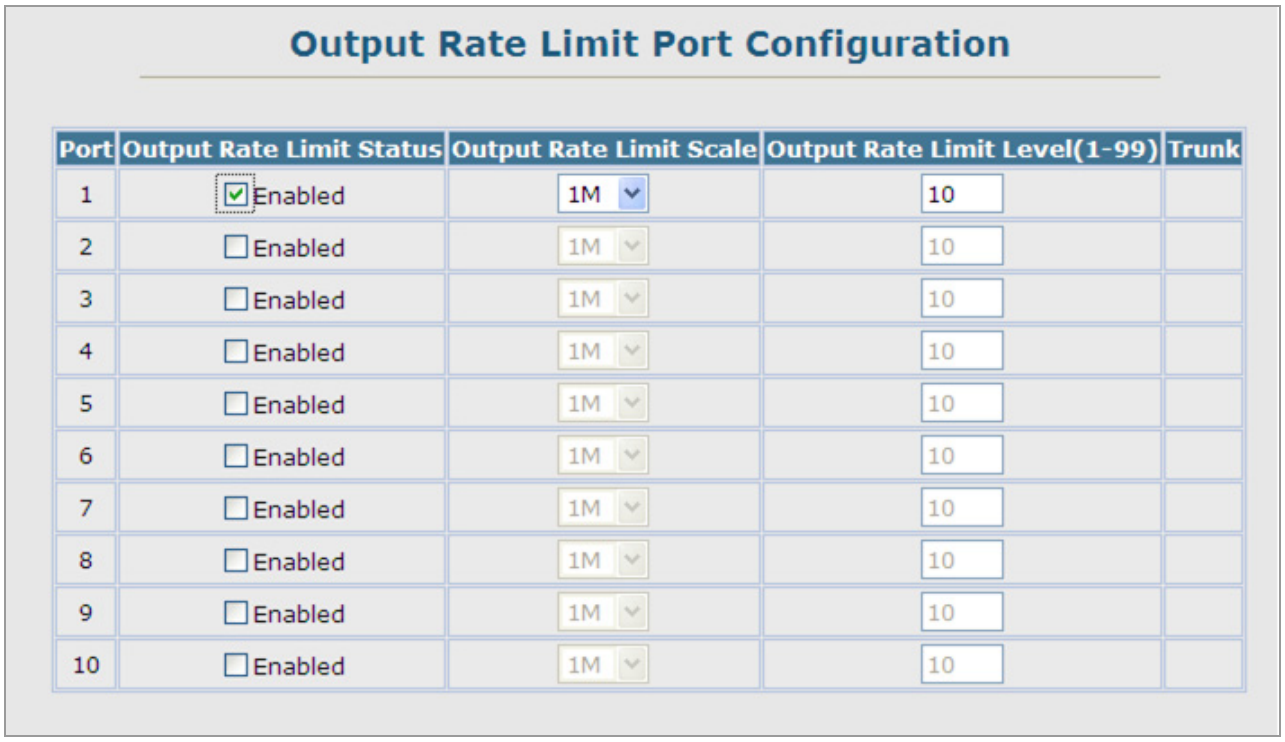


Figure 4-4-9 Output Rate Limit Port Configuration page screenshot

3. Click Port, Rate Limit, Output Port Configuration.
4. Enable the Rate Limit Status for the required interfaces, set the Rate Limit Scale and Rate Limit Level, and click Apply.

The page includes the following fields:

Object	Description
• **Port/Trunk**	Displays the port/trunk number
• **Output Rate Limit Status**	Enables or disables the rate limit. (Default: **Enabled**)
• **Output Rate Limit Scale/Level**	Multiplied by one another, the scale and level set the rate limit. For example, to limit port traffic to 500K bytes per second, choose 100K under Rate Limit Scale and 5 under Rate Limit Level.

4.4.6 Port Statistics

You can display standard statistics on network traffic from the Interfaces Group and Ethernet-like MIBs, as well as a detailed breakdown of traffic based on the RMON MIB. Interfaces and Ethernet-like statistics display errors on the traffic passing through each port. This information can be used to identify potential problems with the switch (such as a faulty port or unusually heavy loading).

RMON statistics provide access to a broad range of statistics, including a total count of different frame types and sizes passing through each port. All values displayed have been accumulated since the last system reboot, and are shown as counts per second. Statistics are refreshed every 60 seconds by default.

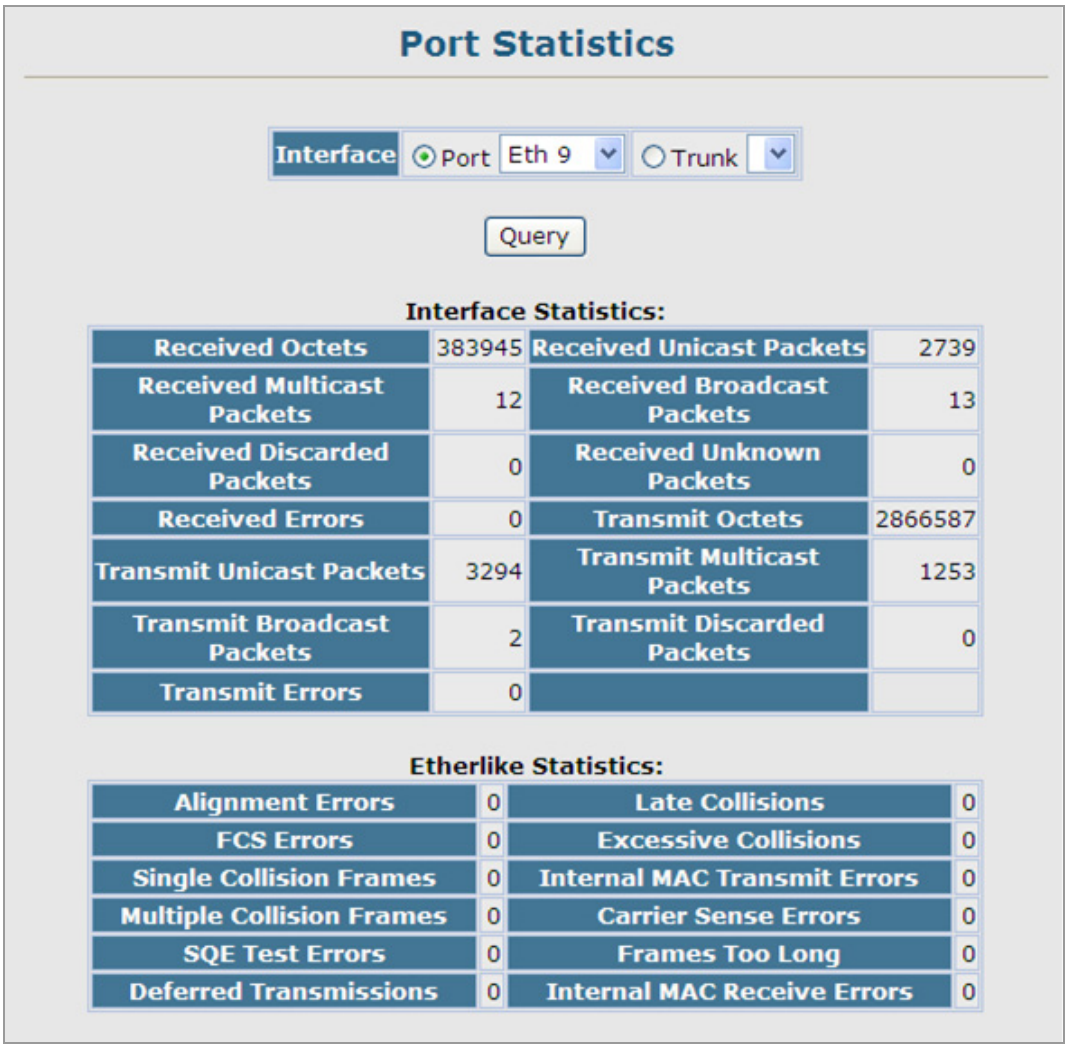
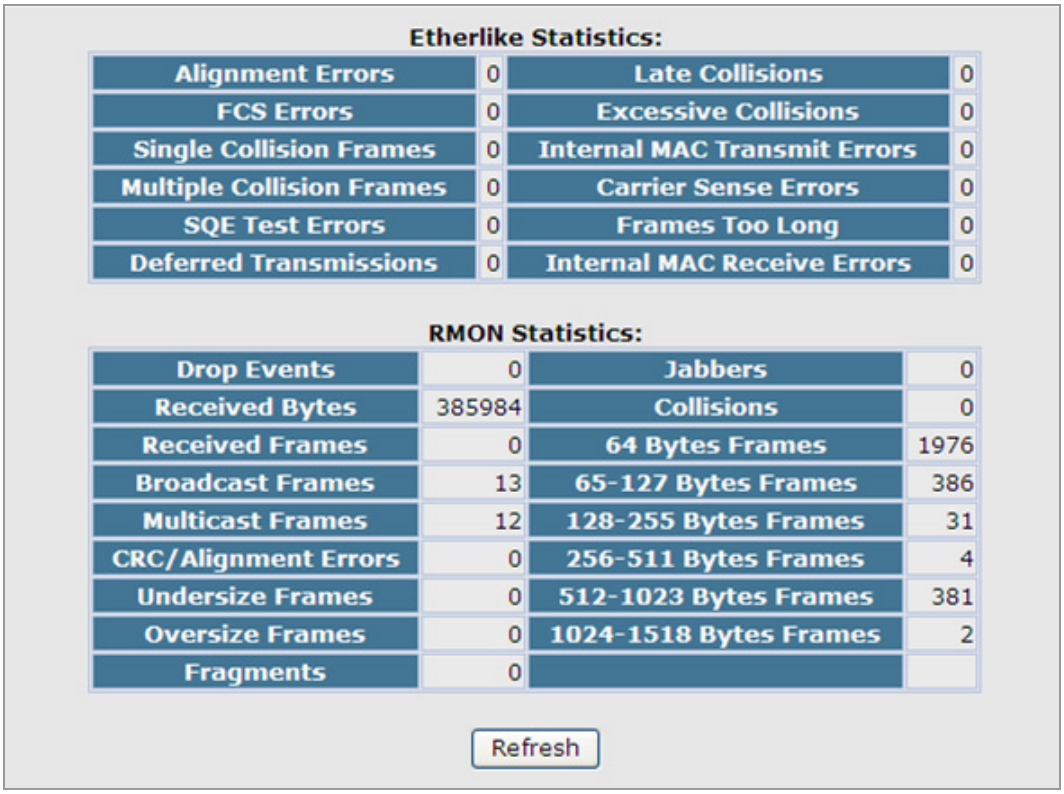


Figure 4-4-10 Port Statistics page screenshot



Etherlike Statistics:

Alignment Errors	0	Late Collisions	0
FCS Errors	0	Excessive Collisions	0
Single Collision Frames	0	Internal MAC Transmit Errors	0
Multiple Collision Frames	0	Carrier Sense Errors	0
SQE Test Errors	0	Frames Too Long	0
Deferred Transmissions	0	Internal MAC Receive Errors	0

RMON Statistics:

Drop Events	0	Jabbers	0
Received Bytes	385984	Collisions	0
Received Frames	0	64 Bytes Frames	1976
Broadcast Frames	13	65-127 Bytes Frames	386
Multicast Frames	12	128-255 Bytes Frames	31
CRC/Alignment Errors	0	256-511 Bytes Frames	4
Undersize Frames	0	512-1023 Bytes Frames	381
Oversize Frames	0	1024-1518 Bytes Frames	2
Fragments	0		

Refresh

Figure 4-4-11 Port Statistics page screenshot

Note

RMON groups 2, 3 and 9 can only be accessed using SNMP management software such as HP OpenView.

The page includes the following fields:

Object	Description
• **Received Octets**	The total number of octetts received on the interface, including framing characters.
• **Received Unicast Packets**	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
• **Received Multicast Packets**	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
• **Received Broadcast Packets**	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
• **Received Discarded Packets**	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
• **Received Unknown Packets**	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.

• **Received Errors**	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
• **Transmit Octets**	The total number of octets transmitted out of the interface, including framing characters.
• **Transmit Unicast Packets**	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

Table 4-2-2 Port Statistics :

Parameter	Description
Interface Statistics	
Received Octets	The total number of octetts received on the interface, including framing characters.
Received Unicast Packets	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
Received Multicast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
Received Broadcast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
Received Discarded Packets	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to ahigher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Received Unknown Packets	The number of packets received via the interface which were discardedbecause of an unknown or unsupported protocol.
Received Errors	The number of inbound packets that contained errors preventing themfrom being deliverable to a higher-layer protocol.
Transmit Octets	The total number of octets transmitted out of the interface, including framing characters.
Transmit Unicast Packets	The total number of packets that higher-level protocols requested betransmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Parameter	Description
Transmit Multicast Packets	The total number of packets that higher-level protocols requested betransmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent.
Transmit Broadcast Packets	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.

Transmit Discarded Packets	The number of outbound packets which were chosen to be discarded eventhough no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Transmit Errors	The number of outbound packets that could not be transmitted because of errors.
Etherlike Statistics	
Alignment Errors	The number of alignment errors (missynchronized data packets).
Late Collisions	The number of times that a collision is detected later than 512 bit-times into the transmission of a packet.
FCS Errors	A count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check. This count does not include frames received with frame-too-long or frame-too-short error.
Excessive Collisions	A count of frames for which transmission on a particular interface fails due to excessive collisions. This counter does not increment when the interface is operating in full-duplex mode.
Single Collision Frames	The number of successfully transmitted frames for which transmission isinhibited by exactly one collision.
Internal MAC Transmit Errors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error.
Multiple Collision Frames	A count of successfully transmitted frames for which transmission is inhibited by more than one collision.
Carrier Sense Errors	The number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
SQE Test Errors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface.
Frames Too Long	A count of frames received on a particular interface that exceed the maximum permitted frame size.
Deferred Transmissions	A count of frames for which the first transmission attempt on a particularinterface is delayed because the medium was busy.
Internal MAC Receive Errors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error.
RMON Statistics	
Drop Events	The total number of events in which packets were dropped due to lack of resources.
Jabbers	The total number of frames received that were longer than 1518 octets(excluding framing bits, but including FCS octets), and had either an FCS or alignment error.
Received Bytes	Total number of bytes of data received on the network. This statistic can be used as a reasonable indication of Ethernet utilization.
Collisions	The best estimate of the total number of collisions on this Ethernet segment.

Received Frames	The total number of frames (bad, broadcast and multicast) received.
Broadcast Frames	The total number of good frames received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Frames	The total number of good frames received that were directed to this multicast address.
CRC/Alignment Errors	The number of CRC/alignment errors (FCS or alignment errors).
Undersize Frames	The total number of frames received that were less than 64 octets long(excluding framing bits, but including FCS octets) and were otherwise well formed.
Oversize Frames	The total number of frames received that were longer than 1518 octets(excluding framing bits, but including FCS octets) and were otherwise well formed.
Fragments	The total number of frames received that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS or alignment error.
64 Bytes Frames	The total number of frames (including bad packets) received andtransmitted that were 64 octets in length (excluding framing bits but including FCS octets).
65-127 Byte Frames 128-255 Byte Frames 256-511 Byte Frames 512-1023 Byte Frames 1024-1518 Byte Frames 1519-1536 Byte Frames	The total number of frames (including bad packets) received andtransmitted where the number of octets fall within the specified range (excluding framing bits but including FCS octets).

4.5 Link Aggregation

Ports can be combined into an aggregate connection. Trunks can be manually set up or dynamically configured using IEEE 802.3-2005 (formerly IEEE 802.3ad) Link Aggregation Control Protocol (LACP). The additional ports dramatically increase the throughput across any connection, and provide redundancy by taking over the load if a port in the trunk should fail. The Managed Switch supports up to 12 trunks.

This section has the following items:

- **Trunk Information** — Displays trunk connection status
- **Trunk Configuration** — Configures trunk connection settings
- **Trunk Membership** — Specifies ports to group into static trunks
- **LACP** — Link Aggregation Control Protocol
  - **Configuration** — Allows ports to dynamically join trunks
  - **Aggregation Port** — Configures parameters for link aggregation group members
  - **Port Counters Information** — Displays statistics for LACP protocol messages
  - **Port Internal Information** — Displays settings and operational state for the local side
  - **Port Neighbors Information** — Displays settings and operational state for the remote side
- **Trunk Broadcast Control** — Sets the broadcast storm threshold for each trunk

You can create multiple links between devices that work as one virtual, aggregate link. A port trunk offers a dramatic increase in bandwidth for network segments where bottlenecks exist, as well as providing a fault-tolerant link between two devices. You can create up to 5/12 trunks at a time.

The Managed Switch supports both **static trunking** and **dynamic Link Aggregation Control Protocol (LACP)**. Static trunks have to be manually configured at both ends of the link, and the switches must comply with the Cisco EtherChannel standard. On the other hand, LACP configured ports can automatically negotiate a trunked link with LACP-configured ports on another device. You can configure any number of ports on the switch as LACP, as long as they are not already configured as part of a static trunk. If ports on another device are also configured as LACP, the Managed Switch and the other device will negotiate a trunk link between them. If an LACP trunk consists of more than eight ports, all other ports will be placed in a standby mode. Should one link in the trunk fail, one of the standby ports will automatically be activated to replace it.

Command Usage

Besides balancing the load across each port in the trunk, the other ports provide redundancy by taking over the load if a port in the trunk fails. However, before making any physical connections between devices, use the web interface or CLI to specify the trunk on the devices at both ends. When using a port trunk, take note of the following points:

- Finish configuring port trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- You can create up to 12 trunks on a Managed Switch, with up to eight ports per trunk.
- The ports at both ends of a connection must be configured as trunk ports.

- When configuring static trunks on switches of different types, they must be compatible with the Cisco EtherChannel standard.
- The ports at both ends of a trunk must be configured in an identical manner, including communication mode (i.e., speed, duplex mode and flow control), VLAN assignments, and CoS settings.
- Any of the Gigabit ports on the front panel can be trunked together, including ports of different media types.
- All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN.
- STP, VLAN, and IGMP settings can only be made for the entire trunk.

4.5.1 Trunk Information

You can use the Trunk Information pages to display the current connection status, including link state, speed/duplex mode, flow control, and auto-negotiation. To change any of the port settings, use the Trunk Configuration page.

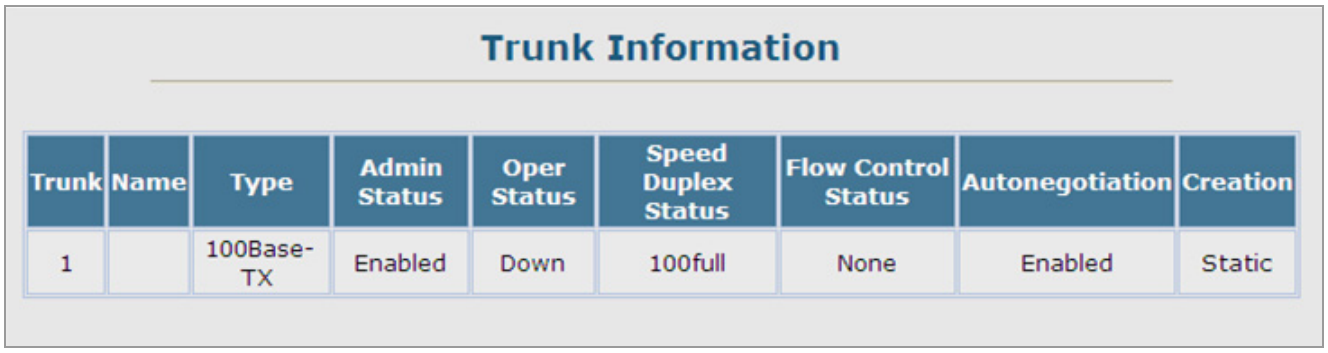


Figure 4-5-1 Trunk Information page screenshot

4.5.2 Trunk Configuration

You can use the Trunk Configuration page to enable/disable an interface, set auto-negotiation and the interface capabilities to advertise, or manually fix the speed, duplex mode, and flow control.

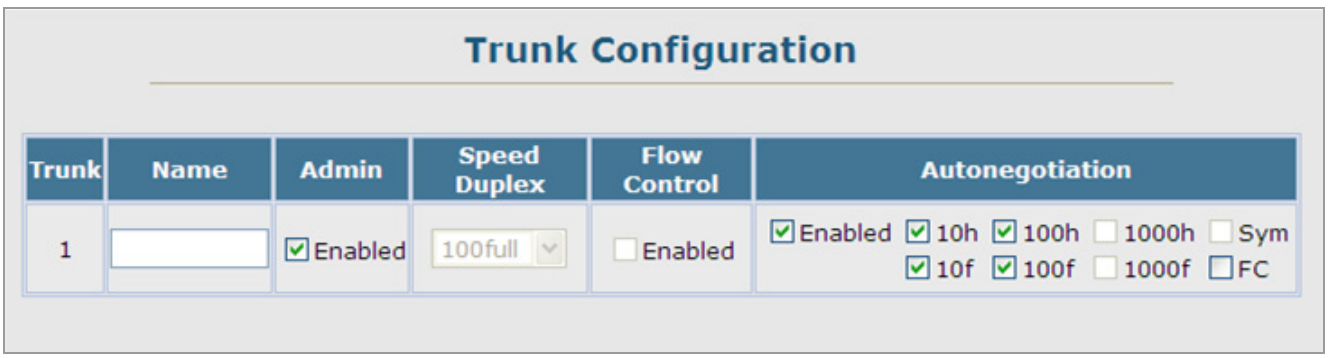


Figure 4-5-2 Trunk Configuration page screenshot

The page includes the following fields:

Object	Description
• **Trunk**	Indicates if a port is a member of a trunk. To create trunks and select port members, see "**Creating Trunk Groups**"
• **Name**	Allows you to label an interface. (Range: 1-64 characters)
• **Admin**	Allows you to manually disable an interface. You can disable an interface due to abnormal behavior (e.g., excessive collisions), and then re-enable it after the problem has been resolved. You may also disable an interface for security reasons.
• **Speed/Duplex**	Allows you to manually set the port speed and duplex mode. (i.e., with auto-negotiation disabled)
• **Flow Control**	Allows automatic or manual selection of flow control (that is, with auto-negotiation disabled). Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, backpressure is used for half-duplex operation and IEEE 802.3-2005 (formally EEE 802.3x) for full-duplex operation. Avoid using flow control on a port connected to a hub unless it is actually required o solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.
• **Autonegotiation**	Allows auto-negotiation to be enabled/ disabled. When auto-negotiation is enabled, you need to specify the capabilities to be advertised. When auto-negotiation is disabled, you can force the settings for speed, mode, and flow control. The following capabilities are supported. **-10half** -Supports 10 Mbps half-duplex operation -**10full** -Supports 10 Mbps full-duplex operation -**100half** - Supports 100 Mbps half-duplex operation -**100full** - Supports 100 Mbps full-duplex operation -**1000full** (Combo ports only) -Supports 1000 Mbps full-duplex operation (Default: Autonegotiation enabled; Advertised capabilities for 100BASE-TX – 10half, 10full, 100half, 100full; 1000BASE-T – 10half, 10full, 100half, 100full, 1000full; 1000BASE-SX/LX/LH – 1000full)

4.5.3 Trunk Broadcast Control

Use the Trunk Broadcast Control page to configure the Broad storm control in the Port Trunk interface.

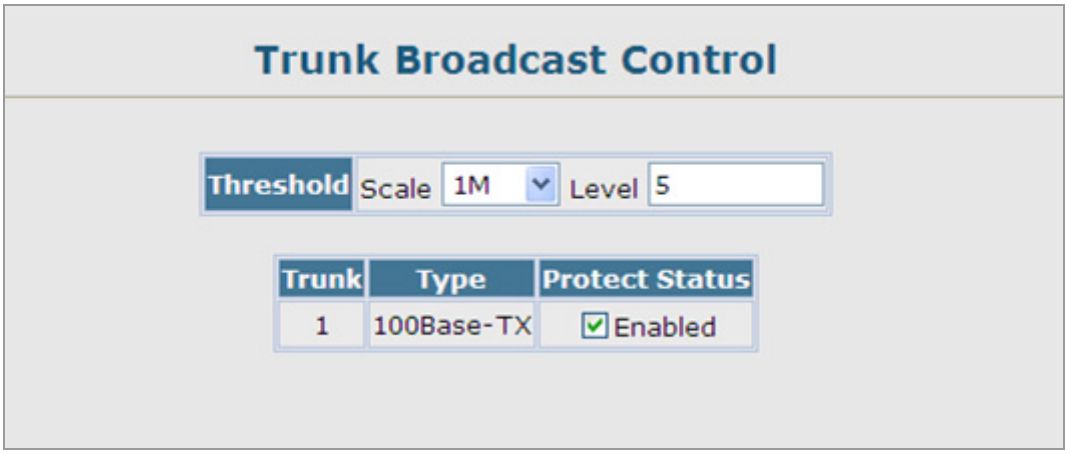


Figure 4-5-3 Trunk Broadcast Control page screenshot

The page includes the following fields:

Object	Description
• **Threshold**	Multiplied by one another, the scale and level set the broadcast threshold. For example, to set a threshold of 500 Kbytes per second, choose 100K under Scale and 5 under Level. Scale Range: 1, 10, 100, 1000 Kbytes per second; Default:**1000** Kbytes per second. Level Range: 1-127; Default: **5**
• **Port**	Port number.
• **Trunk**	Shows if a port is a trunk member.
• **Type**	Indicates the port type. (100BASE-TX, 1000BASE-T, or 1000BASE-SFP)
• **Protect Status**	Enables or disables broadcast storm control. (Default: **Enabled**)
• **Trunk**	Shows if port is a trunk member.

4.5.4 Trunk Membership

When configuring static trunks, you may not be able to link switches of different types, depending on the manufacturer's implementation. However, note that the static trunks on this switch are Cisco EtherChannel compatible.

To avoid creating a loop in the network, be sure you add a static trunk via the configuration interface before connecting the ports, and also disconnect the ports before removing a static trunk via the configuration interface.

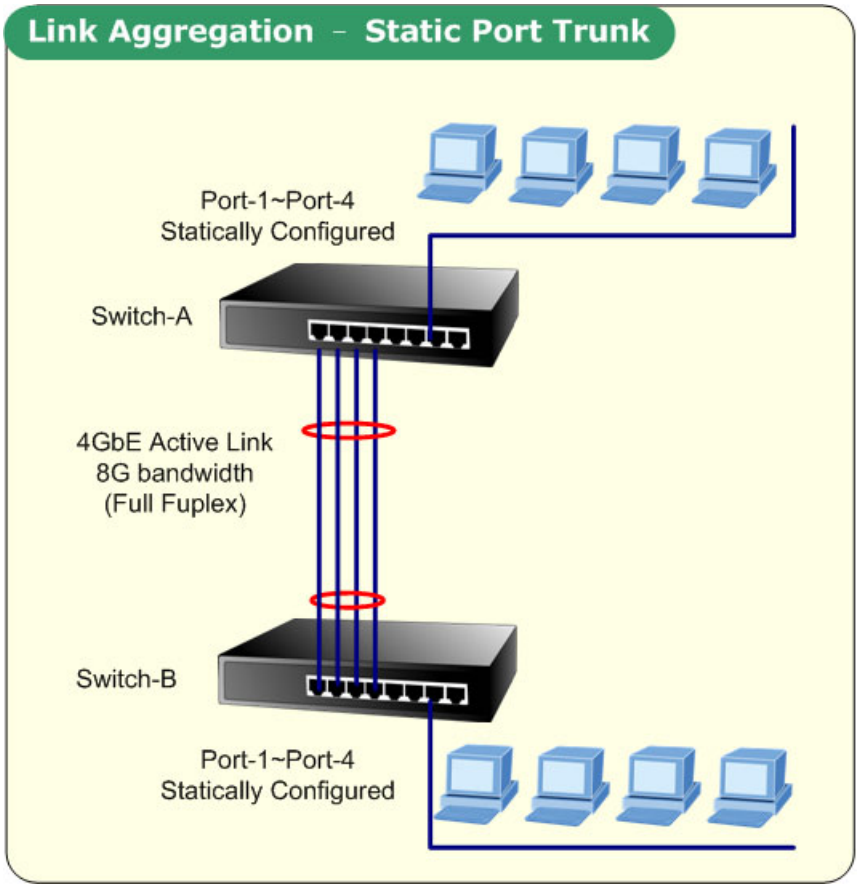


Figure 4-5-4

For additional information, see Configuring Trunks.

Command Sequence - To configure a static trunk:

- Enter a trunk ID of 1-5 in the Trunk field,
- Select any of the Managed Switch ports from the scroll-down port list
- Click **Add**.
- After you have completed adding ports to the member list, click **Apply**.

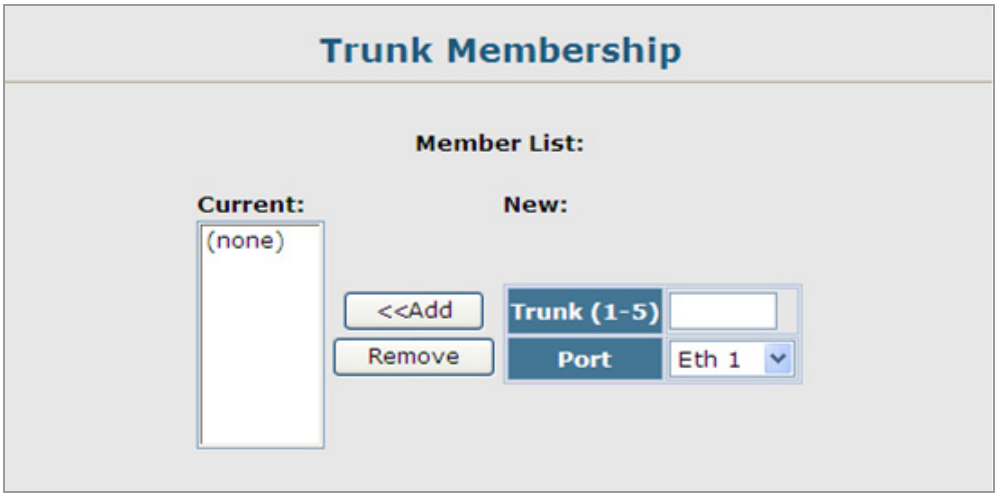


Figure 4-5-5 Trunk Membership page screenshot

1. Click Port, **Trunk Membership**.
2. Enter a trunk ID of 1-12 in the Trunk field, select any of the switch ports from the scroll-down port list, and click Add.
3. After you have completed adding ports to the member list, click Apply.

The page includes the following fields:

Object	Description
• **Member List**	Shows configured trunks (Trunk ID, Unit, Port).
• **New**	Includes entry fields for creating new trunks.
• **Trunk**	Trunk identifier. (SGSD-1022 / SGSD-1022P Range: 1-5) (SGSW-2840 / SGSW-2840P Range: 1-12)
• **Port**	Port identifier. (SGSD-1022 / SGSD-1022P Range: 1-10) (SGSW-2840 / SGSW-2840P Range: 1-28)

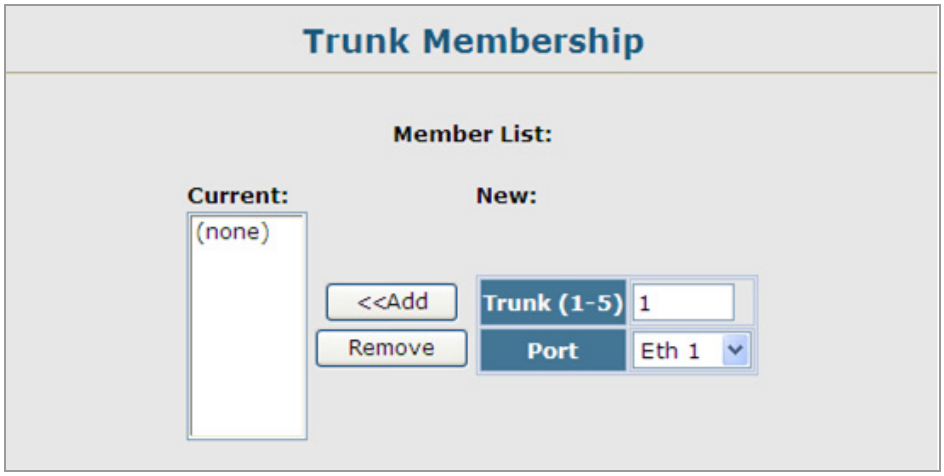


Figure 4-5-6 Trunk Membership page screenshot

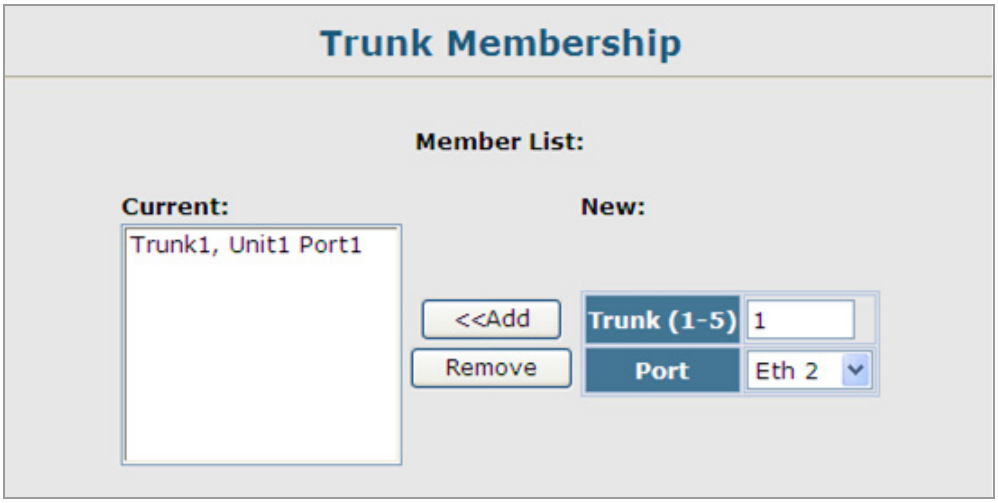


Figure 4-5-7 Trunk Membership page screenshot

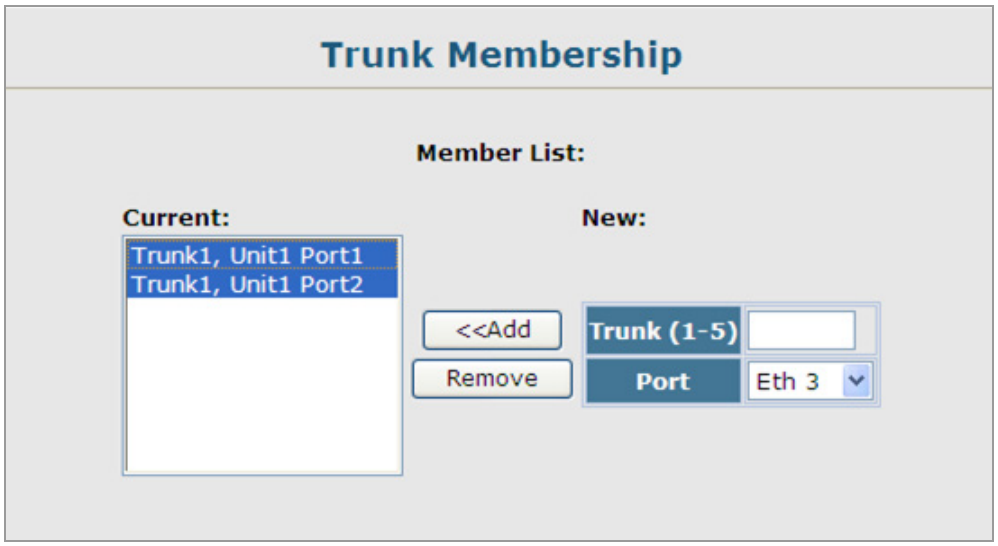


Figure 4-5-8 Trunk Membership page screenshot

4.5.5 LACP

Dynamic **Link Aggregation Control Protocol (LACP)** configured ports can automatically negotiate a trunked link with LACP-configured ports on another device. You can configure any number of ports on the switch as LACP, as long as they are not already configured as part of a static trunk. If ports on another device are also configured as LACP, the Managed Switch and the other device will negotiate a trunk link between them. If an LACP trunk consists of more than eight ports, all other ports will be placed in a standby mode. Should one link in the trunk fail, one of the standby ports will automatically be activated to replace it.

Enabling LACP on Selected Ports

Command Usage

- To avoid creating a loop in the network, be sure you enable LACP before connecting the ports, and also disconnect the ports before disabling LACP.
- If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- A trunk formed with another switch using LACP will automatically be assigned the next available trunk ID.
- If more than eight ports attached to the same mode, and will only be enabled if one of the active links fails.
- All ports on both ends of an LACP trunk must be configured for full duplex, and auto-negotiation.
- Trunks dynamically established through LACP will also be shown in the Member List on the Trunk Membership menu.

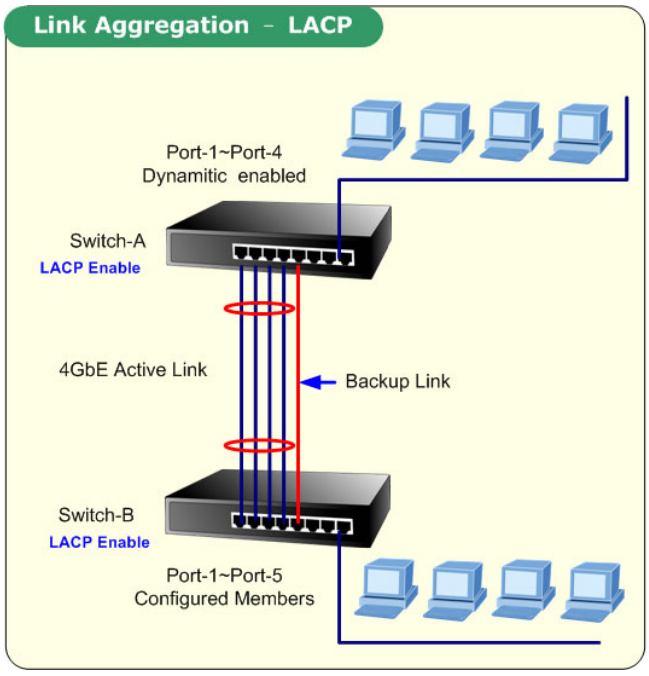


Figure 4-5-9

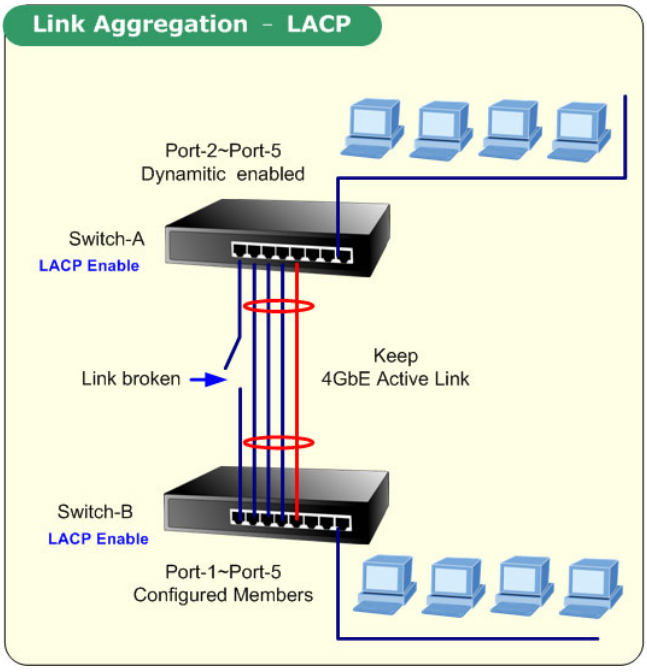


Figure 4-5-10

4.5.5.1 LACP Configuration

Select any of the switch ports from the list and click Add or Remove.

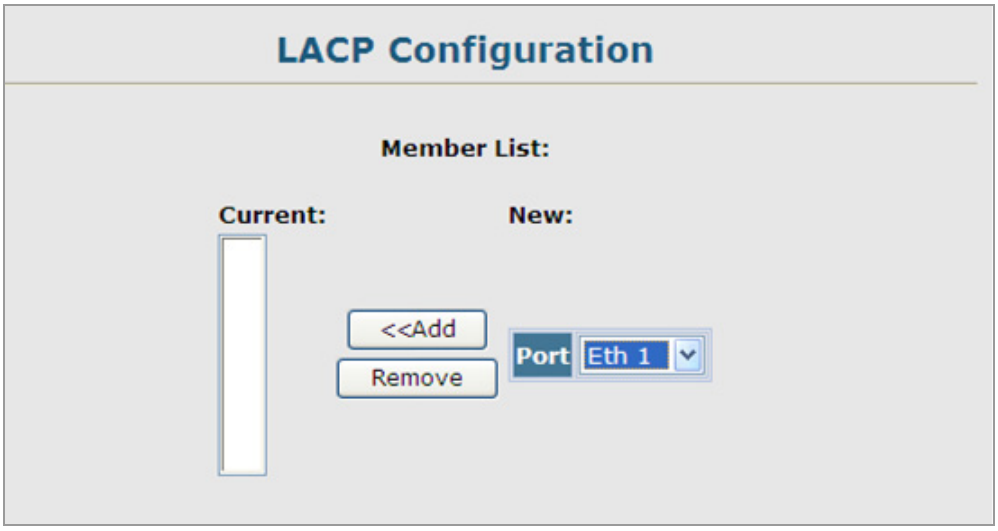


Figure 4-5-11 LACP Configuration page screenshot

1. Click Port, LACP, Configuration.
2. Select any of the switch ports from the scroll-down port list and click Add.
3. After you have completed adding ports to the member list, click Apply.

The page includes the following fields:

Object	Description
• **Member List**	Shows configured trunks (Trunk ID, Unit, Port).
• **New**	Includes entry fields for creating new trunks.
• **Port**	Port identifier. (SGSD-1022 / SGSD-1022P Range: 1-10) (SGSW-2840 / SGSW-2840P Range: 1-28)

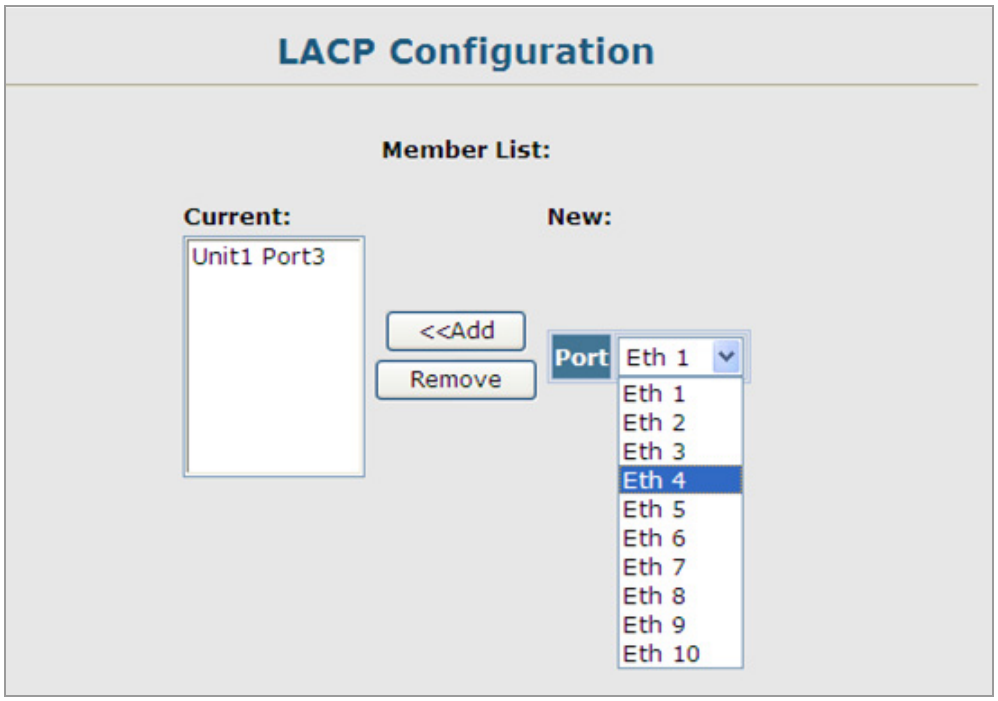


Figure 4-5-12 LACP Configuration page screenshot

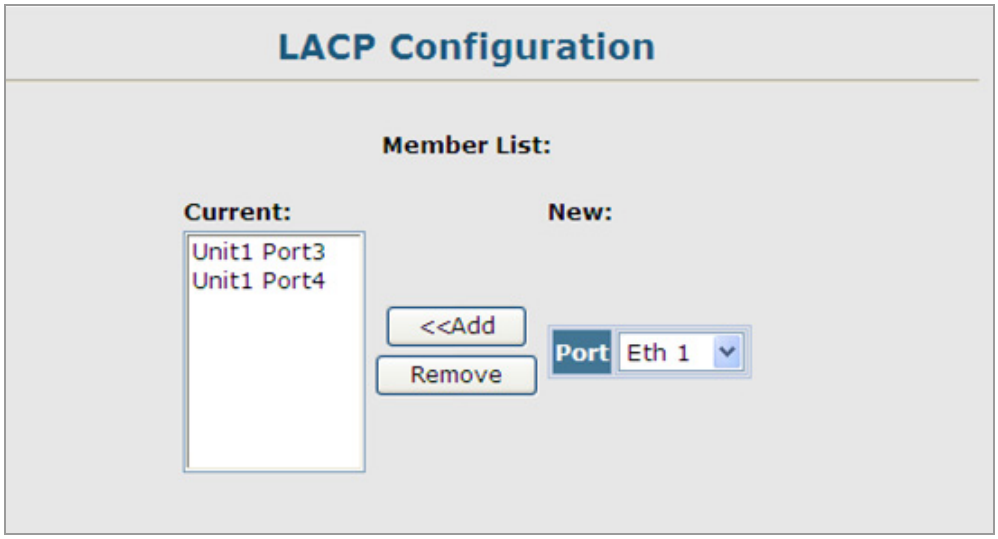


Figure 4-5-13 LACP Configuration page screenshot

4.5.5.2 LACP Aggregation Port

Dynamically Creating a Port Channel

- Ports assigned to a common port channel must meet the following criteria:
- Ports must have the same LACP System Priority.
- Ports must have the same LACP port Admin Key.
- However, if the "port channel" Admin Key is set , then the port Admin Key must be set to the same value for a port to be allowed to join a channel group.

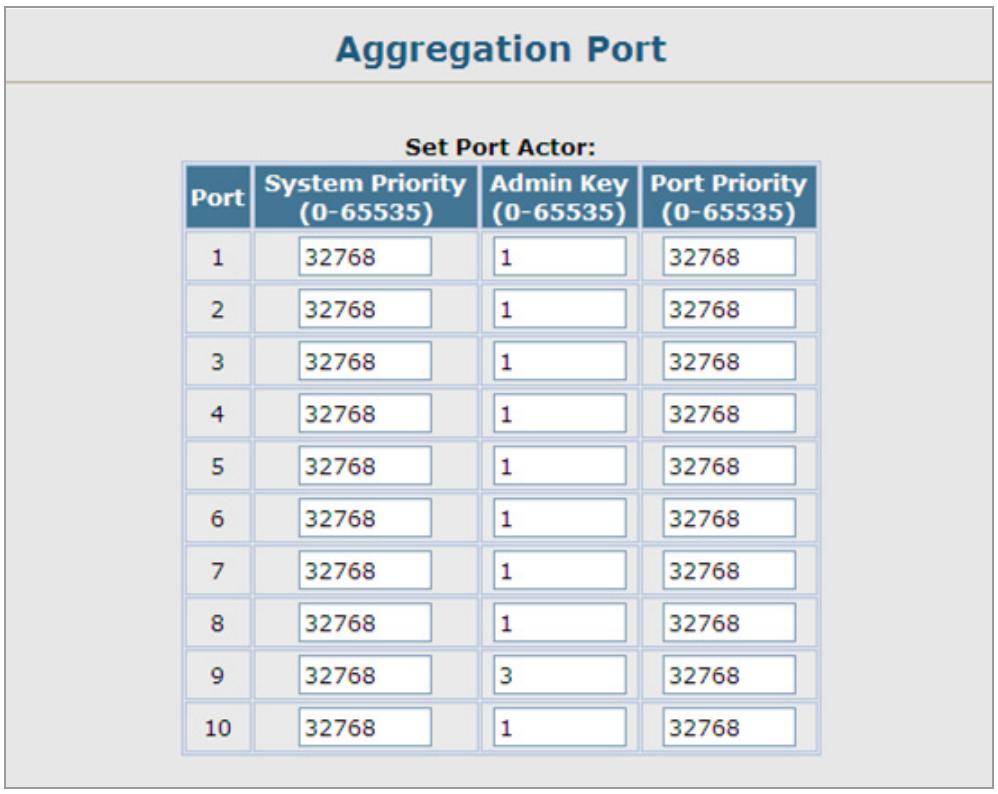


Figure 4-5-14 Aggregation Port page screenshot

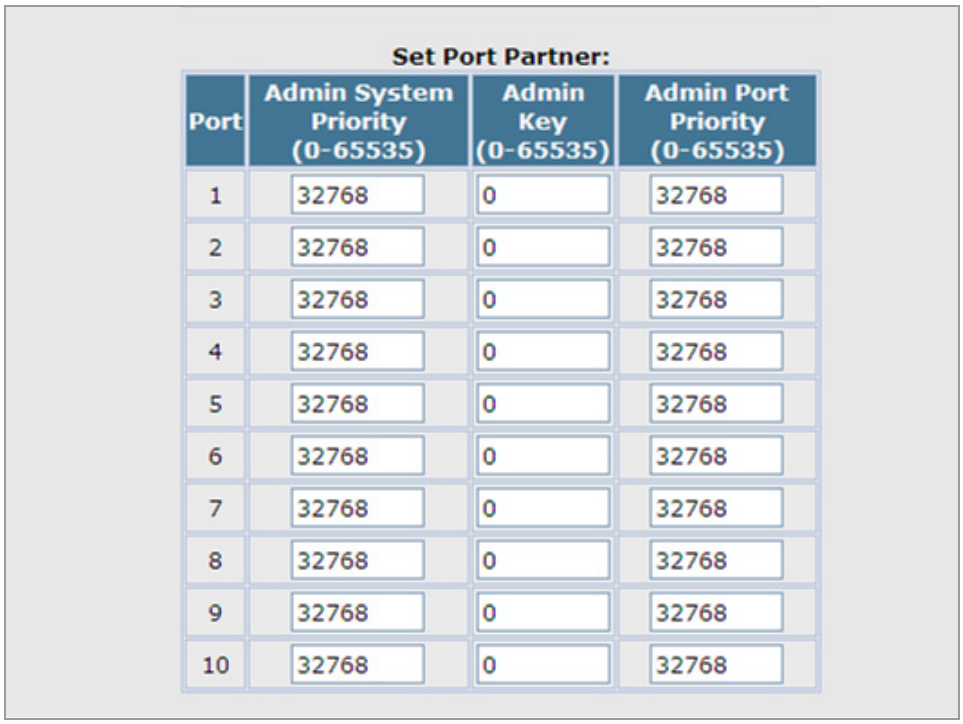


Figure 4-5-15 Aggregation Port page screenshot

1. Click Port, LACP, **Aggregation Port**.
2. Set the System Priority, Admin Key, and Port Priority for the Port Actor.
3. You can optionally configure these settings for the Port Partner. (Be aware that these settings only affect the administrative state of the partner, and will not take effect until the next time an aggregate link is formed with this device.)

4. After you have completed setting the port LACP parameters, click Apply.

The page includes the following fields:

- **Set Port Actor** - This menu sets the local side of an aggregate link; i.e., the ports on this switch.

Object	Description
• **Port**	Port number. (SGSD-1022 / SGSD-1022P Range: 1-10) (SGSW-2840 / SGSW-2840P Range: 1-28)
• **System Priority**	LACP system priority is used to determine **link aggregation group (LAG)** membership, and to identify this device to other switches during LAG negotiations. Range: 0-65535 Default: **32768** - Ports must be configured with the **same system priority** to join the **same LAG**. - System priority is combined with the switch's MAC address to form the LAG identifier. This identifier is used to indicate a specific LAG during LACP negotiations with other systems.
• **Admin Key**	The LACP administration key must be set to the same value for ports that belong to the same LAG. Range: 0-65535; Default: **1**
• **Port Priority**	If a link goes down, LACP port priority is used to select a backup link. Range: 0-65535; Default: **32768**

- **Set Port Partner – This menu sets the remote side of an aggregate link; i.e., the ports on the attached device.**

If the port channel admin key (lacp admin key.) is not set (through the CLI) when a channel group is formed (i.e., it has a null value of 0), this key is set to the same value as the port admin key used by the interfaces that joined the group (lacp admin key, as described in this section).

4.5.5.3 Displaying LACP Port Counters

You can display statistics for LACP protocol messages.

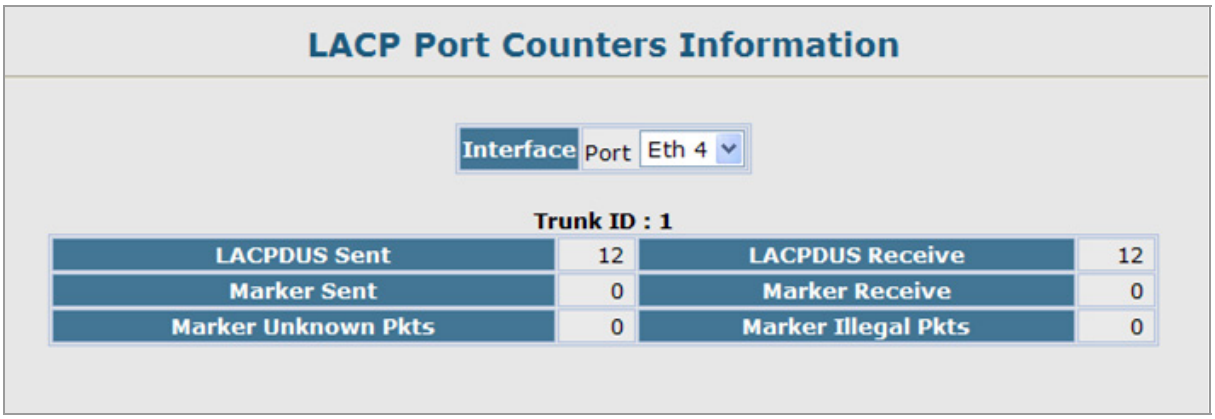


Figure 4-5-16 LACP Port Counter Information page screenshot

The page includes the following fields:

Object	Description
• **LACPDUs Sent**	Number of valid LACPDUs transmitted from this channel group.
• **LACPDUs Received**	Number of valid LACPDUs received on this channel group.
• **Marker Sent**	Number of valid Marker PDUs transmitted from this channel group.
• **Marker Received**	Number of valid Marker PDUs received by this channel group.
• **Marker Unknown Pkts**	Number of frames received that either (1) Carry the Slow Protocols Ethernet Type value, but contain an unknown PDU, or (2) are addressed to the Slow Protocols group MAC Address, but do not carry the Slow Protocols Ethernet Type.
• **Marker Illegal Pkts**	Number of frames that carry the Slow Protocols Ethernet Type value, but contain a badly formed PDU or an illegal value of Protocol Subtype.

4.5.5.4 Displaying LACP Settings and Status for the Local Side

You can display configuration settings and the operational state for the local side of a link aggregation.

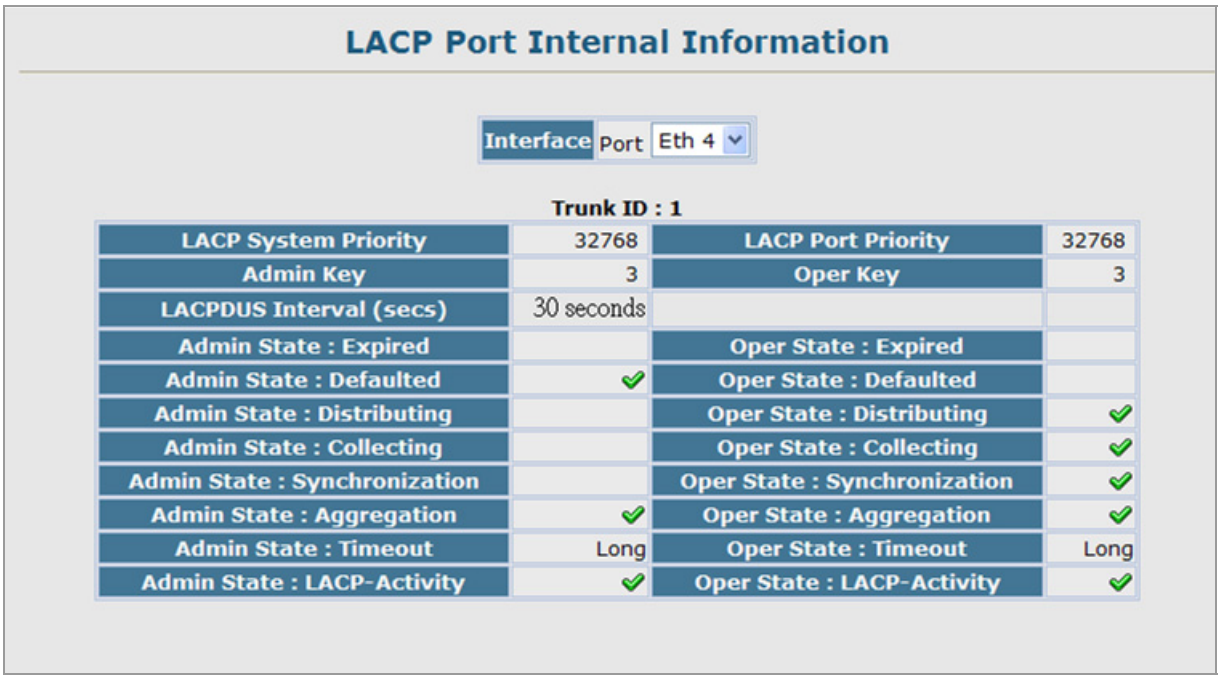

LACP Port Internal Information
Interface Port Eth 4
Trunk ID : 1
LACP System Priority 32768
LACP Port Priority 32768
Admin Key 3
Oper Key 3
LACPDUS Interval (secs) 30 seconds
Admin State : Expired
Oper State : Expired
Admin State : Defaulted
Oper State : Defaulted
Admin State : Distributing
Oper State : Distributing
Admin State : Collecting
Oper State : Collecting
Admin State : Synchronization
Oper State : Synchronization
Admin State : Aggregation
Oper State : Aggregation
Admin State : Timeout Long
Oper State : Timeout Long
Admin State : LACP-Activity
Oper State : LACP-Activity

Figure 4-5-17 LACP Port Internal Information page screenshot

The page includes the following fields:

Object	Description
• **Oper Key**	Current operational value of the key for the aggregation port.
• **Admin Key**	Current administrative value of the key for the aggregation port.
• **LACPDUs Interval**	Number of seconds before invalidating received LACPDU information.
• **LACP System Priority**	LACP system priority assigned to this port channel.
• **LACP Port Priority**	LACP port priority assigned to this interface within the channel group.
• **Admin State, Oper State**	Administrative or operational values of the actor's state parameters: • Expired – The actor's receive machine is in the expired state; • Defaulted – The actor's receive machine is using defaulted operational partner information, administratively configured for the partner. • Distributing – If false, distribution of outgoing frames on this link is disabled; i.e., distribution is currently disabled and is not expected to be enabled in the absenceof administrative changes or changes in received protocol information. • Collecting – Collection of incoming frames on this link is enabled; i.e., collectionis currently enabled and is not expected to be disabled in the absence of administrative changes or changes in received protocol information. • Synchronization – The System considers this link to be IN_SYNC; i.e., it has

	been allocated to the correct Link Aggregation Group, the group has been associated with a compatible Aggregator, and the identity of the Link Aggregation Group is consistent with the System ID and operational Key information transmitted. • Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation. • Long timeout – Periodic transmission of LACPDUs uses a slow transmission rate. • LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)

4.5.5.5 Displaying LACP Status for the Remote Side

You can display configuration settings and the operational state for the remote side of a link aggregation.

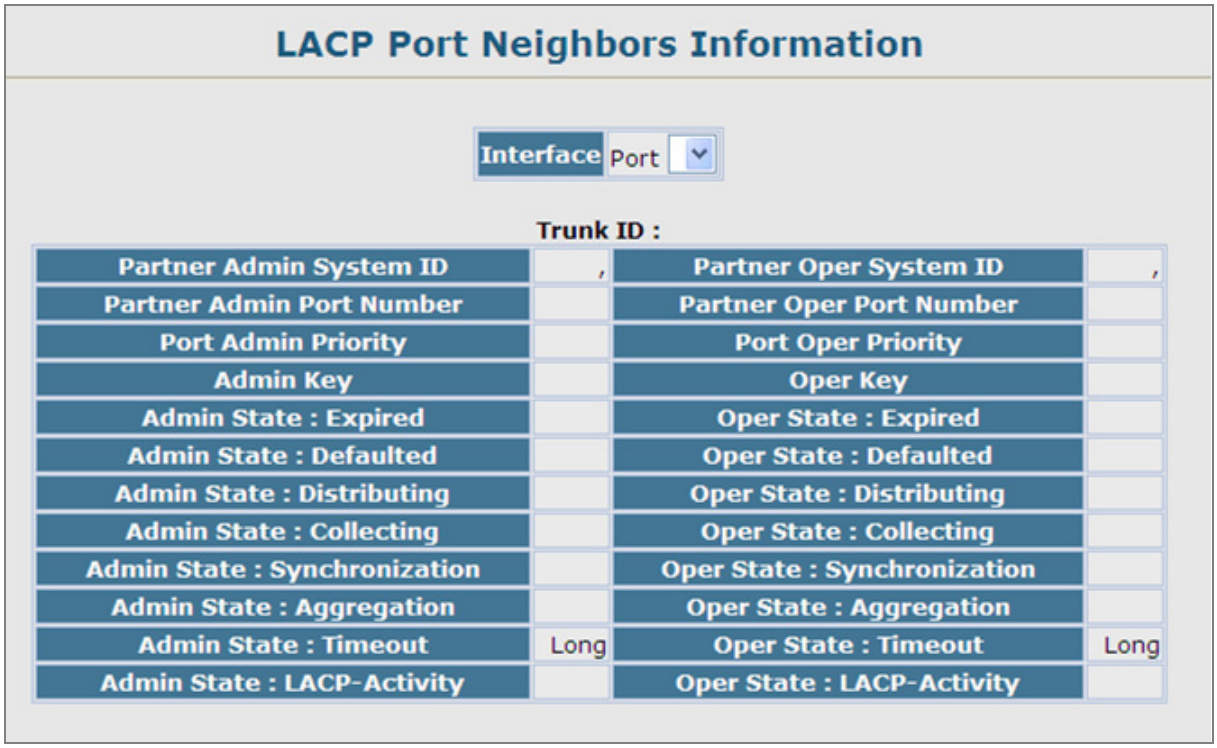


Figure 4-5-17 LACP Port Internal Information page screenshot

The page includes the following fields:

Object	Description
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.

Partner Admin Port Number	Current administrative value of the port number for the protocol Partner.
Partner Oper Port Number	Operational port number assigned to this aggregation port by the port's protocol partner.
Port Admin Priority	Current administrative value of the port priority for the protocol partner.
Port Oper Priority	Priority value assigned to this aggregation port by the partner.
Admin Key	Current administrative value of the Key for the protocol partner.
Oper Key	Current operational value of the Key for the protocol partner.
Admin State	Administrative values of the partner's state parameters. (See preceding table.)
Oper State	Operational values of the partner's state parameters. (See preceding table.)

4.6 Address Table

Switches store the addresses for all known devices. This information is used to pass traffic directly between the inbound and outbound ports. All the addresses learned by monitoring traffic are stored in the dynamic address table. You can also manually configure static addresses that are bound to a specific port.

4.6.1 Static Addresses

A static address can be assigned to a specific interface on this Managed Switch. Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.

Command Sequence - Specify the **interface**, the **MAC address** and **VLAN**, then click Add Static Address.

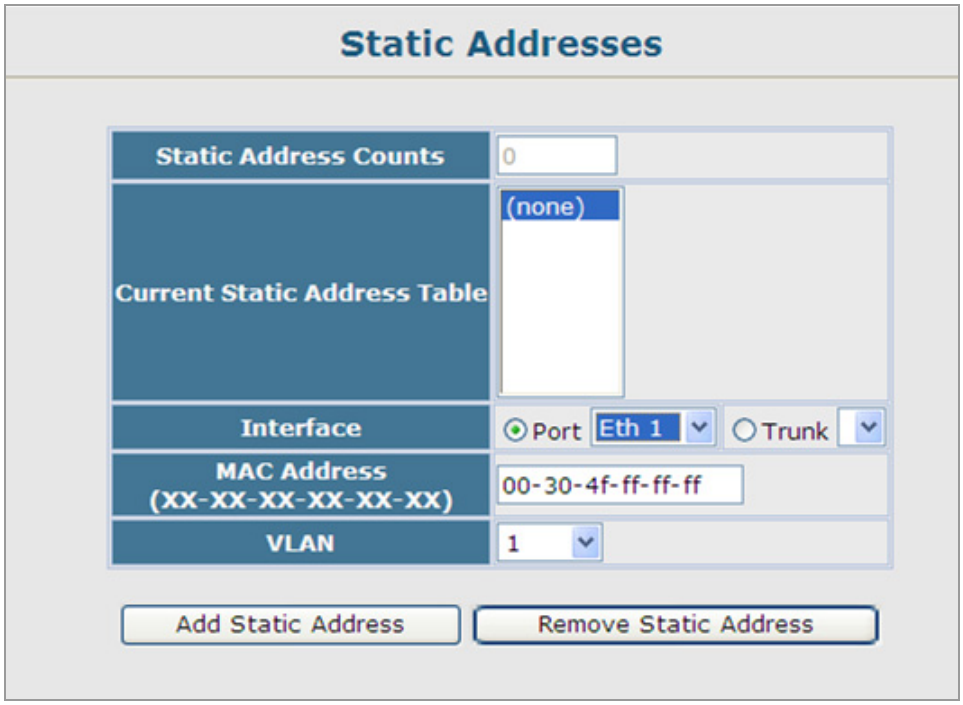


Figure 4-6-1 Static Addresses page screenshot

1. Click Address Table, **Static Addresses**.
2. Specify the interface, the MAC address and VLAN, then click Add Static Address.

The page includes the following fields:

Object	Description
• **Static Address Counts**	The number of manually configured addresses.
• **Current Static Address**	Lists all the static addresses.

Table	
• **Interface**	Port or trunk associated with the device assigned a static address.
• **MAC Address**	Physical address of a device mapped to this interface.
• **VLAN**	ID of configured VLAN (1-4094).

■ **Static MAC Address example:**

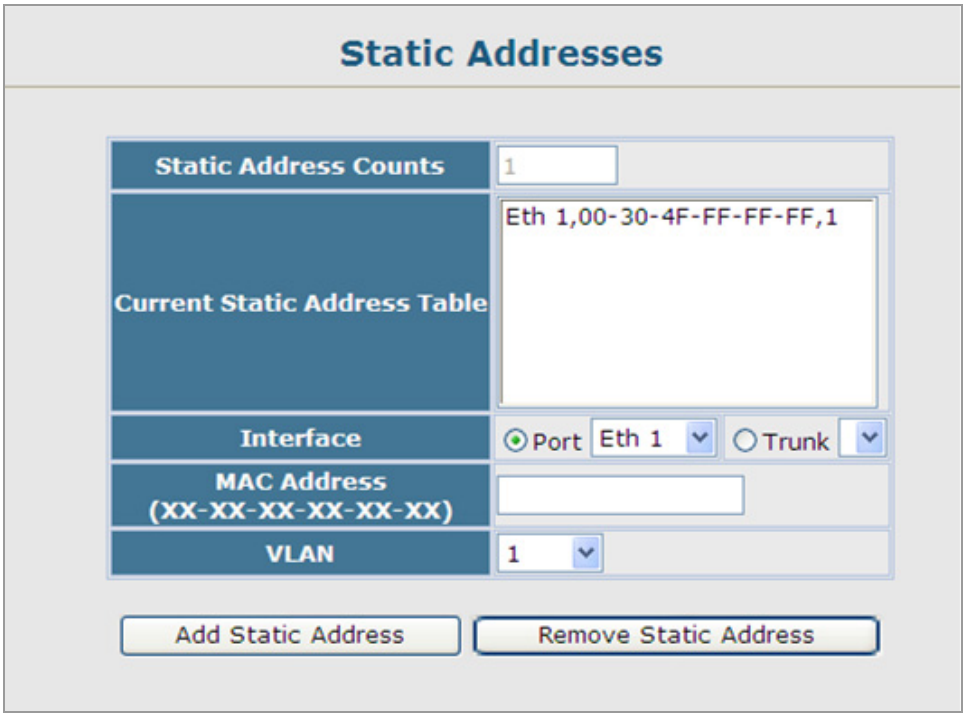


Figure 4-6-2 Static Addresses page screenshot

4.6.2 Dynamic Addresses

The Dynamic Address Table contains the MAC addresses learned by monitoring the **source address** for traffic entering the switch. When the destination address for inbound traffic is found in the database, the packets intended for that address are forwarded directly to the associated port. Otherwise, the traffic is flooded to all ports.

Command Sequence - Specify the search **type** (i.e., mark the Interface, MAC Address, or VLAN checkbox), select the method of sorting the displayed addresses, and then click Query.

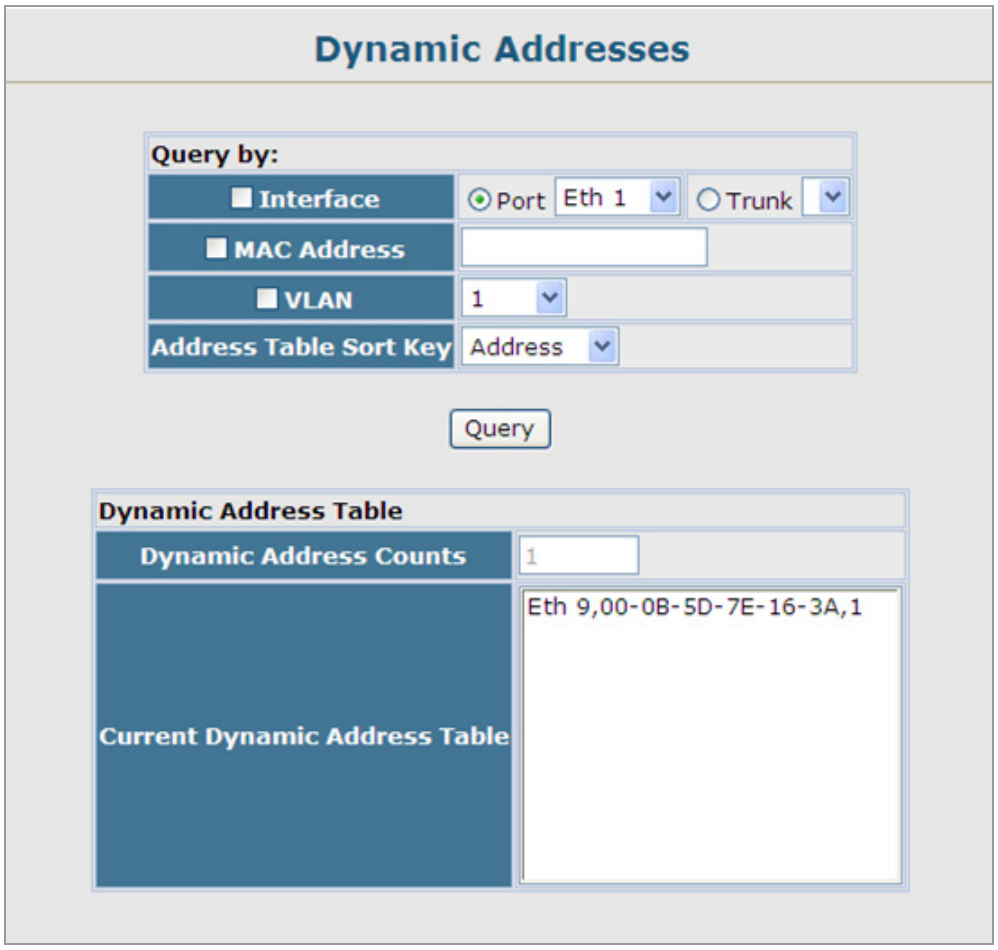


Figure 4-6-3 Dynamic Addresses page screenshot

1. Click Address Table, Dynamic Addresses.
2. Specify the search type (i.e., mark the Interface, MAC Address, or VLAN checkbox), select the method of sorting the displayed addresses, and then click Query.

The page includes the following fields:

Object	Description
• **Interface**	Indicates a port or trunk.
• **MAC Address**	Physical address associated with this interface.
• **VLAN**	ID of configured VLAN (1-4094).
• **Address Table Sort Key**	You can sort the information displayed based on MAC address, VLAN or interface (port or trunk).
• **Dynamic Address Counts**	The number of addresses dynamically learned.
• **Current Dynamic Address Table**	Lists all the dynamic addresses.

4.6.3 Address Aging

You can set the aging time for entries in the Dynamic Address Table.

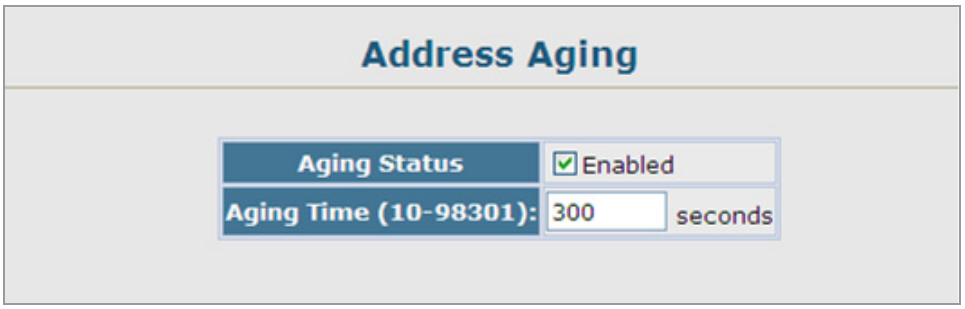


Figure 4-6-4 Dynamic Addresses page screenshot

The page includes the following fields:

Object	Description
• **Aging Status**	Enables/disables the function.
• **Aging Time**	The time after which a learned entry is discarded. (Range: 10-98301 seconds; Default: 300 seconds)

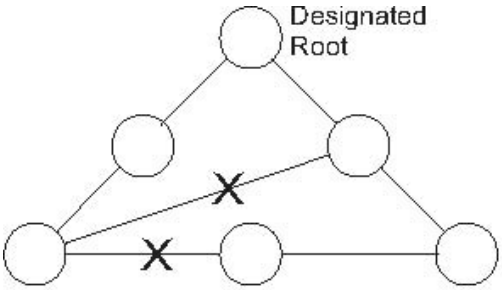
4.7 Spanning Tree

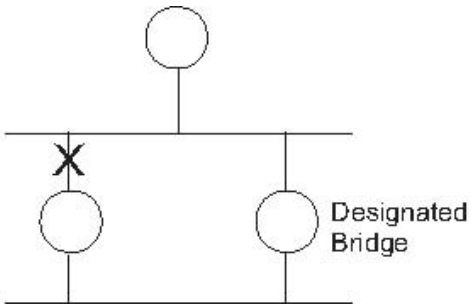
Spanning Tree Protocol

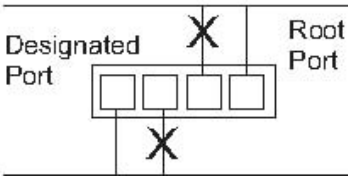
The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only one route exists between any two stations on the network, and provide backup links which automatically take over when a primary link goes down. The spanning tree algorithms supported by this switch include these versions:

- **STP – Spanning Tree Protocol (IEEE 802.1D)**
- **RSTP – Rapid Spanning Tree Protocol (IEEE 802.1w)**
- **MSTP – Multiple Spanning Tree Protocol (IEEE 802.1s)**

STP – STA uses a distributed algorithm to select a bridging device (STA-compliant switch, bridge or router) that serves as the root of the spanning tree network. It selects a root port on each bridging device (except for the root device) which incurs the lowest path cost when forwarding a packet from that device to the root device. Then it selects a designated bridging device from each LAN which incurs the lowest path cost when forwarding a packet from that LAN to the root device. All ports connected to designated bridging devices are assigned as designated ports. After determining the lowest cost spanning tree, it enables all root ports and designated ports, and disables all other ports. Network packets are therefore only forwarded between root ports and designated ports, eliminating any possible network loops.





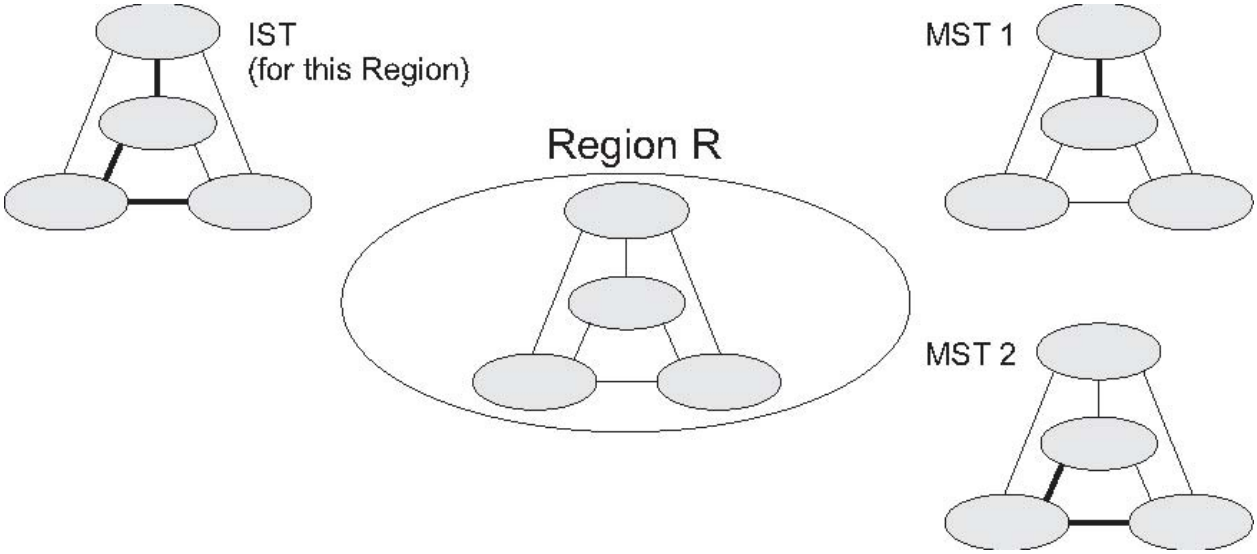


Once a stable network topology has been established, all bridges listen for Hello **BPDUs (Bridge Protocol Data Units)** transmitted from the Root Bridge. If a bridge does not get a Hello BPDU after a predefined interval (Maximum Age), the bridge assumes that the link to the Root Bridge is down. This bridge will then initiate negotiations with other bridges to reconfigure the network to reestablish a valid network topology.

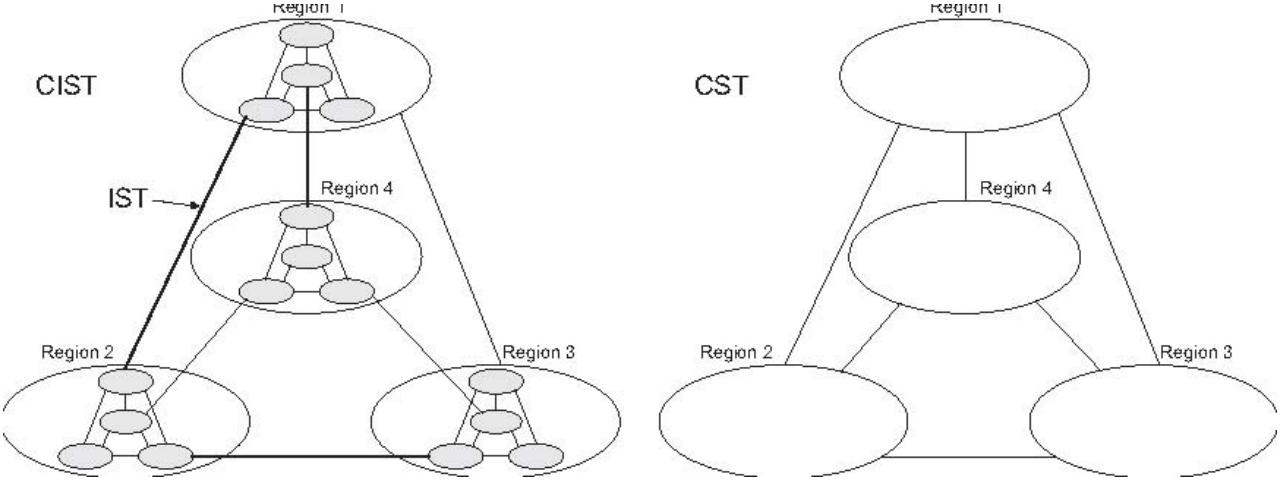
RSTP – RSTP is designed as a general replacement for the slower, legacy STP. RSTP is also incorporated into MSTP. RSTP achieves must faster reconfiguration (i.e., around 1 to 3 seconds, compared to 30 seconds or more for STP) by reducing the number of state changes before active ports start learning, predefining an alternate route that can be used when a node or port fails, and retaining the forwarding database for ports insensitive to changes in the tree structure when reconfiguration occurs.

MSTP – When using STP or RSTP, it may be difficult to maintain a stable path between all VLAN members. Frequent changes in the tree structure can easily isolate some of the group members. MSTP (which is based on RSTP for fast convergence) is

designed to support independent spanning trees based on VLAN groups. Using multiple spanning trees can provide multiple forwarding paths and enable load balancing. One or more VLANs can be grouped into a Multiple Spanning Tree Instance (MSTI). MSTP builds a separate Multiple Spanning Tree (MST) for each instance to maintain connectivity among each of the assigned VLAN groups. MSTP then builds a Internal Spanning Tree (IST) for the Region containing all commonly configured MSTP bridges.



An MST Region consists of a group of interconnected bridges that have the same MST Configuration Identifiers (including the Region Name, Revision Level and Configuration Digest – see "**Configuring Multiple Spanning Trees**"). An MST Region may contain multiple MSTP Instances. An **Internal Spanning Tree (IST)** is used to connect all the MSTP switches within an MST region. A **Common Spanning Tree (CST)** interconnects all adjacent MST Regions, and acts as a virtual bridge node for communications with STP or RSTP nodes in the global network.



MSTP connects all bridges and LAN segments with a single **Common and Internal Spanning Tree (CIST)**. The CIST is formed as a result of the running spanning tree algorithm between switches that support the STP, RSTP, MSTP protocols.

The IEEE 802.1D Spanning Tree Protocol and IEEE 802.1W Rapid Spanning Tree Protocol allow for the blocking of links between switches that form loops within the network. When multiple links between switches are detected, a primary link is established. Duplicated links are blocked from use and become standby links. The protocol allows for the duplicate links to be used in the event of a failure of the primary link. Once the Spanning Tree Protocol is configured and enabled, primary links are established and duplicated links are blocked automatically. The reactivation of the blocked links (at the time of a primary link failure) is also accomplished automatically without operator intervention.

This automatic network reconfiguration provides maximum uptime to network users. However, the concepts of the Spanning Tree Algorithm and protocol are a complicated and complex subject and must be fully researched and understood. It is possible to cause serious degradation of the performance of the network if the Spanning Tree is incorrectly configured. Please read the following before making any changes from the default values.

The Switch STP performs the following functions:

- Creates a single spanning tree from any combination of switching or bridging elements.
- Creates multiple spanning trees – from any combination of ports contained within a single switch, in user specified groups.
- Automatically reconfigures the spanning tree to compensate for the failure, addition, or removal of any element in the tree.
- Reconfigures the spanning tree without operator intervention.

Bridge Protocol Data Units

For STP to arrive at a stable network topology, the following information is used:

- The unique switch identifier
- The path cost to the root associated with each switch port
- The por tidentifier

STP communicates between switches on the network using Bridge Protocol Data Units (BPDUs). Each BPDU contains the following information:

- The unique identifier of the switch that the transmitting switch currently believes is the root switch
- The path cost to the root from the transmitting port
- The port identifier of the transmitting port

The switch sends BPDUs to communicate and construct the spanning-tree topology. All switches connected to the LAN on which the packet is transmitted will receive the BPDU. BPDUs are not directly forwarded by the switch, but the receiving switch uses the information in the frame to calculate a BPDU, and, if the topology changes, initiates a BPDU transmission.

The communication between switches via BPDUs results in the following:

- One switch is elected as the root switch
- The shortest distance to the root switch is calculated for each switch
- A designated switch is selected. This is the switch closest to the root switch through which packets will be forwarded to the root.
- A port for each switch is selected. This is the port providing the best path from the switch to the root switch.
- Ports included in the STP are selected.

Creating a Stable STP Topology

It is to make the root port a fastest link. If all switches have STP enabled with default settings, the switch with the lowest MAC address in the network will become the root switch. By increasing the priority (lowering the priority number) of the best switch, STP can be forced to select the best switch as the root switch.

When STP is enabled using the default parameters, the path between source and destination stations in a switched network might not be ideal. For instance, connecting higher-speed links to a port that has a higher number than the current root port can cause a root-port change.

STP Port States

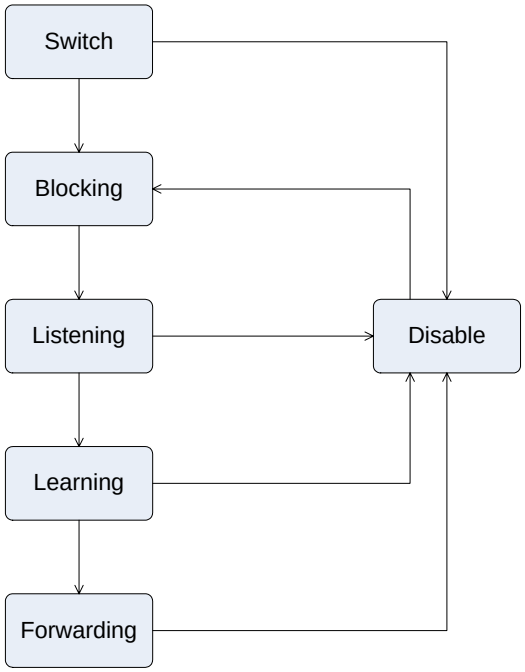
The BPDUs take some time to pass through a network. This propagation delay can result in topology changes where a port that transitioned directly from a Blocking state to a Forwarding state could create temporary data loops. Ports must wait for new network topology information to propagate throughout the network before starting to forward packets. They must also wait for the packet lifetime to expire for BPDU packets that were forwarded based on the old topology. The forward delay timer is used to allow the network topology to stabilize after a topology change. In addition, STP specifies a series of states a port must transition through to further ensure that a stable network topology is created after a topology change.

Each port on a switch using STP exists is in one of the following five states:

- **Blocking** – the port is blocked from forwarding or receiving packets
- **Listening** – the port is waiting to receive BPDU packets that may tell the port to go back to the blocking state
- **Learning** – the port is adding addresses to its forwarding database, but not yet forwarding packets
- **Forwarding** – the port is forwarding packets
- **Disabled** – the port only responds to network management messages and must return to the blocking state first

A port transitions from one state to another as follows:

- From initialization (switch boot) to blocking
- From blocking to listening or to disabled
- From listening to learning or to disabled
- From learning to forwarding or to disabled
- From forwarding to disabled
- From disabled to blocking



STP Port State Transitions

You can modify each port state by using management software. When you enable STP, every port on every switch in the network goes through the blocking state and then transitions through the states of listening and learning at power up. If properly configured, each port stabilizes to the forwarding or blocking state. No packets (except BPDUs) are forwarded from, or received by, STP enabled ports until the forwarding state is enabled for that port.

2. STP Parameters

STP Operation Levels

The Switch allows for two levels of operation: the switch level and the port level. The switch level forms a spanning tree consisting of links between one or more switches. The port level constructs a spanning tree consisting of groups of one or more ports. The STP operates in much the same way for both levels.

On the switch level, STP calculates the Bridge Identifier for each switch and then sets the Root Bridge and the Designated Bridges.
On the port level, STP sets the Root Port and the Designated Ports.

The following are the user-configurable STP parameters for the switch level:

Parameter	Description	Default Value
Bridge Identifier(Not user configurable except by setting priority below)	A combination of the User-set priority and the switch's MAC address. The Bridge Identifier consists of two parts: a 16-bit priority and a 48-bit Ethernet MAC address 32768 + MAC	32768 + MAC

Priority	A relative priority for each switch – lower numbers give a higher priority and a greater chance of a given switch being elected as the root bridge	32768
Hello Time	The length of time between broadcasts of the hello message by the switch	2 seconds
Maximum Age Timer	Measures the age of a received BPDU for a port and ensures that the BPDU is discarded when its age exceeds the value of the maximum age timer.	20 seconds
Forward Delay Timer	The amount time spent by a port in the learning and listening states waiting for a BPDU that may return the port to the blocking state.	15 seconds

The following are the user-configurable STP parameters for the port or port group level:

Variable	Description	Default Value
Port Priority	A relative priority for each port –lower numbers give a higher priority and a greater chance of a given port being elected as the root port	128
Port Cost	A value used by STP to evaluate paths – STP calculates path costs and selects the path with the minimum cost as the active path	200,000-100Mbps Fast Ethernet ports 20,000-1000Mbps Gigabit Ethernet ports 0 - Auto

Default Spanning-Tree Configuration

Feature	Default Value
Enable state	STP disabled for all ports
Port priority	128
Port cost	0
Bridge Priority	32,768

User-Changeable STA Parameters

The Switch's factory default setting should cover the majority of installations. However, it is advisable to keep the default settings as set at the factory; unless, it is absolutely necessary. The user changeable parameters in the Switch are as follows:

Priority – A Priority for the switch can be set from 0 to 65535. 0 is equal to the highest Priority.

Hello Time – The Hello Time can be from 1 to 10 seconds. This is the interval between two transmissions of BPDU packets sent by the Root Bridge to tell all other Switches that it is indeed the Root Bridge. If you set a Hello Time for your Switch, and it is not

the Root Bridge, the set Hello Time will be used if and when your Switch becomes the Root Bridge.

The Hello Time cannot be longer than the Max. Age. Otherwise, a configuration error will occur.

Max. Age – The Max Age can be from 6 to 40 seconds. At the end of the Max Age, if a BPDU has still not been received from the Root Bridge, your Switch will start sending its own BPDU to all other Switches for permission to become the Root Bridge. If it turns out that your Switch has the lowest Bridge Identifier, it will become the Root Bridge.

Forward Delay Timer – The Forward Delay can be from 4 to 30 seconds. This is the time any port on the

Switch spends in the listening state while moving from the blocking state to the forwarding state.

Observe the following formulas when setting the above parameters:

Max. Age _ 2 x (Forward Delay - 1 second)

Max. Age _ 2 x (Hello Time + 1 second)

Port Priority – A Port Priority can be from 0 to 240. The lower the number, the greater the probability the port will be chosen as the Root Port.

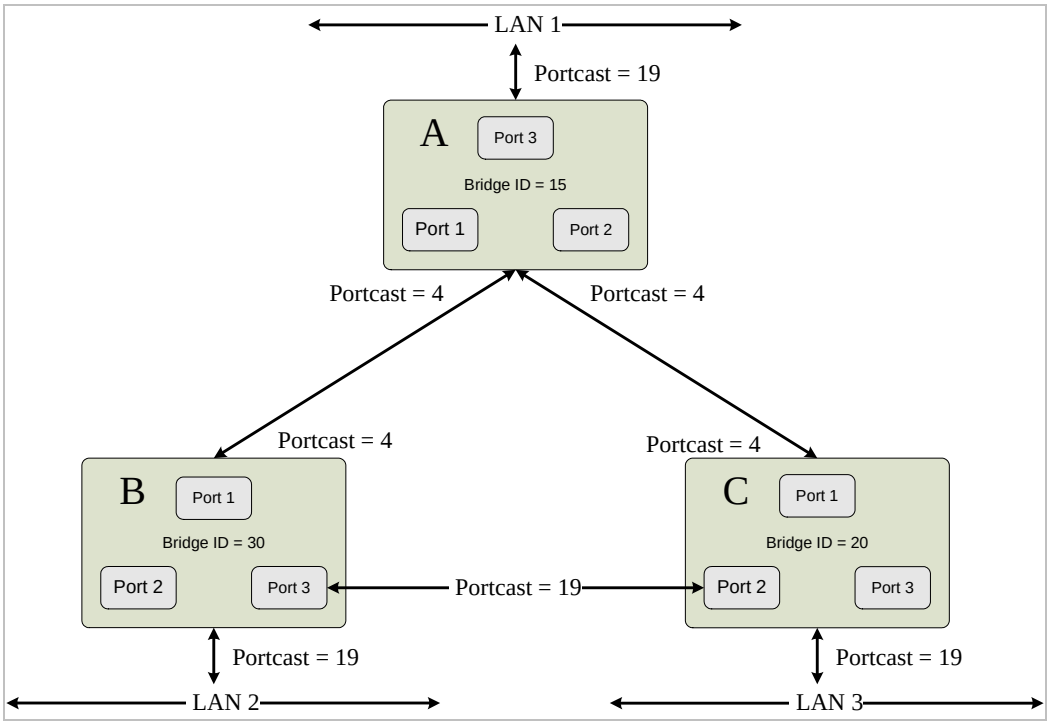
Port Cost – A Port Cost can be set from 0 to 200000000. The lower the number, the greater the probability the port will be chosen to forward packets.

3. Illustration of STP

A simple illustration of three switches connected in a loop is depicted in the below diagram. In this example, you can anticipate some major network problems if the STP assistance is not applied.

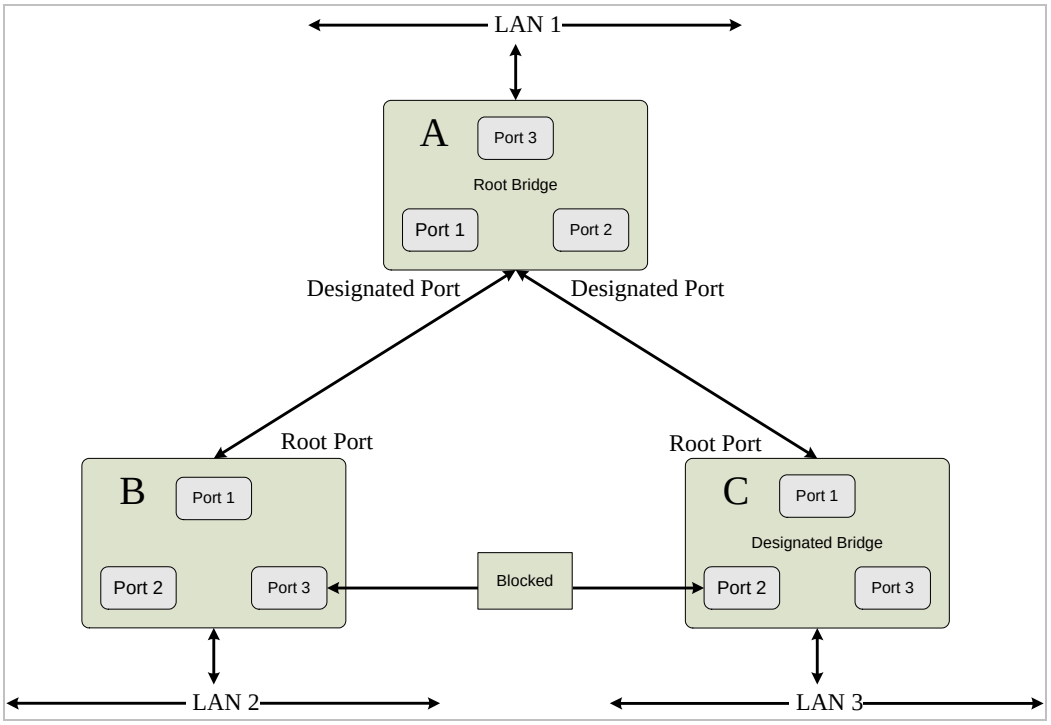
If switch A broadcasts a packet to switch B, switch B will broadcast it to switch C, and switch C will broadcast it to back to switch A and so on. The broadcast packet will be passed indefinitely in a loop, potentially causing a network failure. In this example, STP breaks the loop by blocking the connection between switch B and C. The decision to block a particular connection is based on the STP calculation of the most current Bridge and Port settings.

Now, if switch A broadcasts a packet to switch C, then switch C will drop the packet at port 2 and the broadcast will end there. Setting-up STP using values other than the defaults, can be complex. Therefore, you are advised to keep the default factory settings and STP will automatically assign root bridges/ports and block loop connections. Influencing STP to choose a particular switch as the root bridge using the Priority setting, or influencing STP to choose a particular port to block using the Port Priority and Port Cost settings is, however, relatively straight forward.



Before Applying the STA Rules

In this example, only the default STP values are used.



After Applying the STA Rules

The switch with the lowest Bridge ID (switch C) was elected the root bridge, and the ports were selected to give a high port cost between switches B and C. The two (optional) Gigabit ports (default port cost = 4) on switch A are connected to one (optional) Gigabit port on both switch B and C. The redundant link between switch B and C is deliberately chosen as a 100 Mbps Fast Ethernet link (default port cost = 19). Gigabit ports could be used, but the port cost should be increased from the default to ensure that the link between switch B and switch C is the blocked link.

4.7.1 STA

STP uses a distributed algorithm to select a bridging device (STP-compliant switch, bridge or router) that serves as the root of the spanning tree network. It selects a **root port** on each bridging device (except for the root device) which incurs the **lowest path cost** when forwarding a packet from that device to the root device. Then it selects a **designated bridging** device from each LAN which incurs the lowest path cost when forwarding a packet from that LAN to the root device. All ports connected to designated bridging devices are assigned as designated ports. After determining the lowest cost spanning tree, it enables all root ports and designated ports, and disables all other ports. Network packets are therefore only forwarded between root ports and designated ports, eliminating any possible network loops.

RSTP is designed as a general replacement for the slower, legacy STP. RSTP is also incorporated into MSTP. RSTP achieves must faster reconfiguration (i.e., around one tenth of the time required by STP) by reducing the number of state changes before active ports start learning, predefining an alternate route that can be used when a node or port fails, and retaining the forwarding database for ports insensitive to changes in the tree structure when reconfiguration occurs.

4.7.1.1 Spanning Tree Information

STA Information

This screen displays a summary of the current bridge STA information that applies to the entire Managed Switch using the STP Information screen..

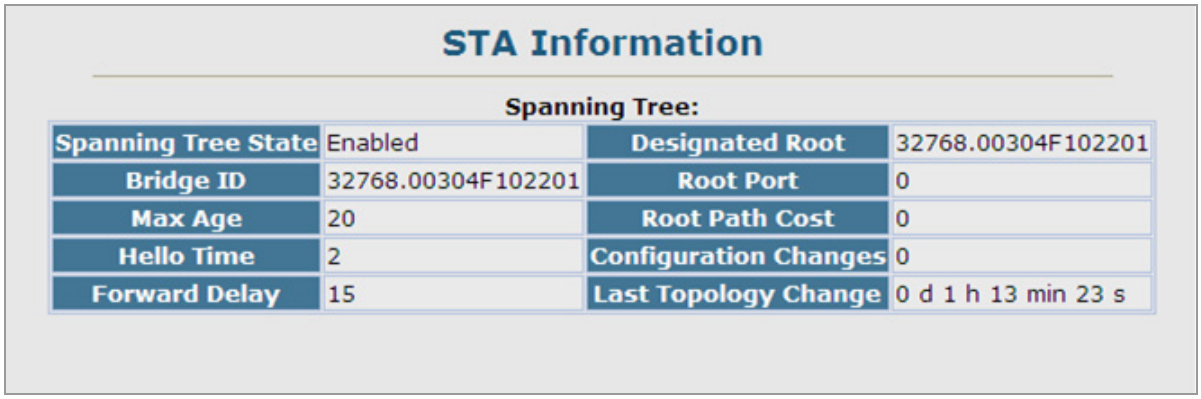


Figure 4-7-1 STA Information page screenshot

The page includes the following fields:

Object	Description
• **Spanning Tree State**	Shows if the Managed Switch is enabled to participate in an STA-compliant network.
• **Bridge ID**	A unique identifier for this bridge, consisting of the bridge priority, the MST Instance ID **0** for the Common Spanning Tree when spanning tree mode is set to **MSTP**, and MAC address (where the address is taken from the switch system).

• **Max Age**	The maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the **designated port** for the attached LAN. If it is a **root port**, a new root port is selected from among the device ports attached to the network. (References to "ports" in this section mean "interfaces," which includes both ports and trunks.)
• **Hello Time**	The time interval (in seconds) at which the root device transmits a configuration message.
• **Forward Delay**	The maximum time (in seconds) the root device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result.
• **Designated Root**	The priority and MAC address of the device in the Spanning Tree that this Managed Switch has accepted as the root device. - **Root Port** The number of the port on this Managed Switch that is closest to the root. This Managed Switch communicates with the root device through this port. If there is no root port, then this Managed Switch has been accepted as the root device of the Spanning Tree network. - **Root Path Cost** The path cost from the root port on this switch to the root device.
• **Configuration Changes**	The number of times the Spanning Tree has been reconfigured.
• **Last Topology Change**	Time since the Spanning Tree was last reconfigured.

The current root port and current root cost display as zero when this device is not connected to the network.

4.7.1.2 STA Configuration

Configuring Global Settings

Global settings apply to the entire Managed Switch.

Command Usage

Spanning Tree Protocol

Uses RSTP for the internal state machine, but sends only 802.1D BPDUs. This creates one spanning tree instance for the entire network. If multiple VLANs are implemented on a network, the path between specific VLAN members may be inadvertently disabled to prevent network loops, thus isolating group members. When operating multiple VLANs, we recommend selecting the MSTP option.

Rapid Spanning Tree Protocol

RSTP supports connections to either STP or RSTP nodes by monitoring the incoming protocol messages and dynamically adjusting the type of protocol messages the RSTP node transmits, as described below:

-**STP Mode** If the switch receives an 802.1D BPDU (i.e., STP BPDU) after a port's migration delay timer expires, the switch assumes it is connected to an 802.1D bridge and starts using only 802.1D BPDUs.

-**RSTP Mode** If RSTP is using 802.1D BPDUs on a port and receives an RSTP BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.

Multiple Spanning Tree Protocol

MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

- -To allow multiple spanning trees to operate over the network, you must configure a related set of bridges with the same MSTP configuration, allowing them to participate in a specific set of spanning tree instances.
- -A spanning tree instance can exist only on bridges that have compatible VLAN instance assignments.
- -Be careful when switching between spanning tree modes. Changing modes stops all spanning-tree instances for the previous mode and restarts the system in the new mode, temporarily disrupting user traffic.

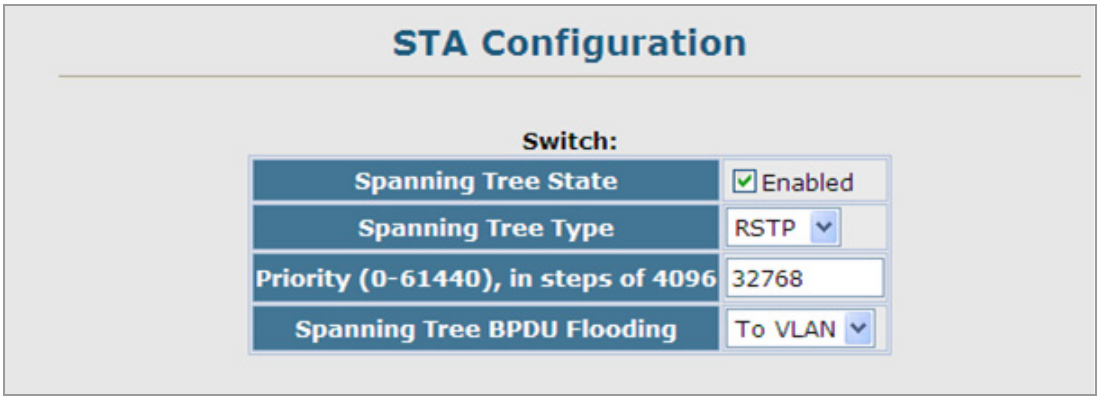


Figure 4-7-2 STA Configuration page screenshot

The page includes the following fields:

■ Basic Configuration of Global Settings

Object	Description
• **Spanning Tree State**	Enables/disables STA on this switch. (Default: **Enabled**)
• **Spanning Tree Type**	Specifies the type of spanning tree used on this switch: - **STP**: Spanning Tree Protocol (**IEEE 802.1D**); i.e., when this option is selected, the switch will use RSTP set to STP forced compatibility mode). - **RSTP**: Rapid Spanning Tree (**IEEE 802.1w**); RSTP is the default. - **MSTP**: Multiple Spanning Tree (**IEEE 802.1s**)
• **Priority**	Bridge priority is used in selecting the **root device**, **root port**, and **designated port.** The device with the highest priority becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device. (Note that lower numeric values indicate higher priority.) - Default: **32768** - Range: 0-61440, in steps of 4096 - Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440

Note

STP and RSTP BPDUs are transmitted as **untagged** frames, and will cross any VLAN boundaries.

■ Root Device Configuration

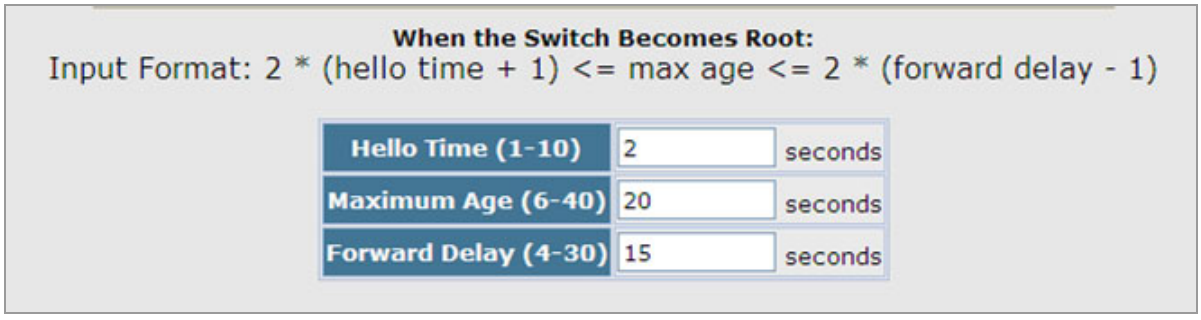


Figure 4-7-3 Root Device Configuration page screenshot

The page includes the following fields:

Object	Description
• **Hello Time**	Interval (in seconds) at which the root device transmits a configuration message. -Default: 2 -Minimum: 1 -Maximum: The lower of 10 or [(Max. Message Age / 2) -1]
• **Maximum Age**	The maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network. (References to "**ports**" in this section mean "interfaces," which includes both ports and trunks.) -Default: 20 -Minimum: The higher of 6 or [2 x (Hello Time + 1)]. -Maximum: The lower of 40 or [2 x (Forward Delay -1)]
• **Forward Delay**	The maximum time (in seconds) this device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result. -Default: 15 -Minimum: The higher of 4 or [(Max. Message Age / 2) + 1] -Maximum: 30

■ Configuration Settings for RSTP

The following attributes apply to both RSTP and MSTP:

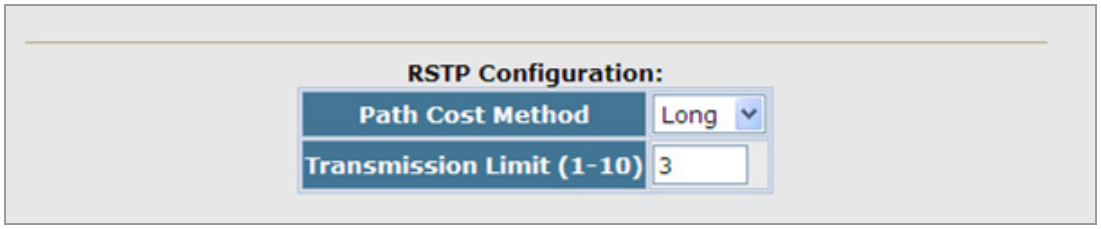


Figure 4-7-4 RSTP Configuration page screenshot

The page includes the following fields:

Object	Description
• **Path Cost Method**	The path cost is used to determine the best path between devices. The path cost method is used to determine the range of values that can be assigned to each interface. - **Long**: Specifies 32-bit based values that range from 1-200,000,000. (This is the default.) - Short: Specifies 16-bit based values that range from 1-65535.
• **Transmission Limit**	The maximum transmission rate for BPDUs is specified by setting the minimum interval between the transmission of consecutive protocol messages. Range: **1-10**; Default: **3**

■ Configuration Settings for MSTP

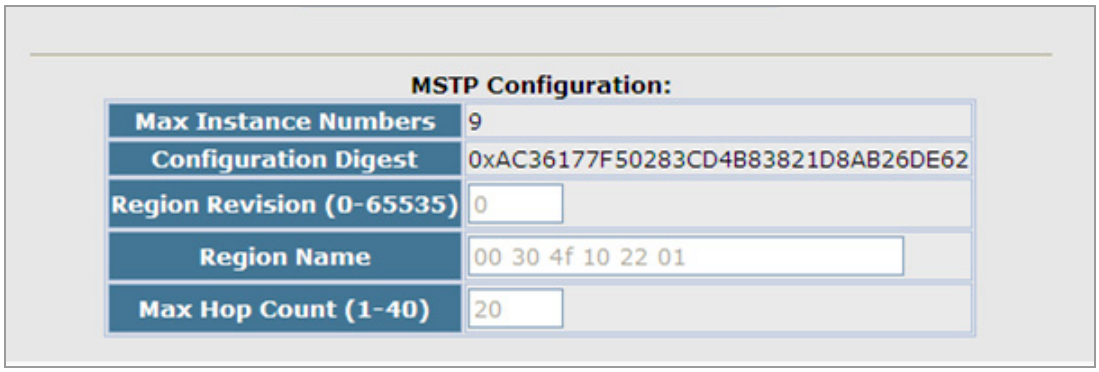


Figure 4-7-5 MSTP Configuration page screenshot

The page includes the following fields:

Object	Description
• **Max Instance Numbers**	The maximum number of MSTP instances to which this Managed Switch can be assigned.
• **Configuration Digest**	An MD5 signature key that contains the VLAN ID to MST ID mapping table. In other words, this key is a mapping of all VLANs to the CIST.
• **Region Revision**	The revision for this MSTI. Range: 0-65535; Default: **0**
• **Region Name**	The name for this MSTI.

	(Maximum length: **32** characters)
• **Maximum Hop Count**	The maximum number of hops allowed in the MST region before a BPDU is discarded. (Range: 1-40; Default: **20**)

The **MST name** and **revision number** are both required to uniquely identify an MST region.

4.7.1.3 STA Port Information

Displaying Interface Settings

These parameters are for port or trunk STA Information.

STA Port Information

Port	Spanning Tree	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Path Cost	Oper Link Type	Oper Edge Port	Port Role	Trunk Member
1	Enabled	Discarding	0	0	32768.00304F102201	128.1	100000	Point-to-Point	Enabled	Disabled	
2	Enabled	Discarding	0	0	32768.00304F102201	128.2	100000	Point-to-Point	Enabled	Disabled	
3	Enabled	Discarding	0	0	32768.00304F102201	128.3	100000	Point-to-Point	Enabled	Disabled	
4	Enabled	Discarding	0	0	32768.00304F102201	128.4	100000	Point-to-Point	Enabled	Disabled	
5	Enabled	Discarding	0	0	32768.00304F102201	128.5	100000	Point-to-Point	Enabled	Disabled	
6	Enabled	Discarding	0	0	32768.00304F102201	128.6	100000	Point-to-Point	Enabled	Disabled	
7	Enabled	Discarding	0	0	32768.00304F102201	128.7	100000	Point-to-Point	Enabled	Disabled	
8	Enabled	Discarding	0	0	32768.00304F102201	128.8	100000	Point-to-Point	Enabled	Disabled	
9	Enabled	Forwarding	1	0	32768.00304F102201	128.9	100000	Point-to-Point	Enabled	Designated	
10	Enabled	Discarding	2	0	32768.00304F102201	128.10	10000	Point-to-Point	Enabled	Disabled	

Figure 4-7-6 STA Port Information page screenshot

The page includes the following fields:

Object	Description
• **Spanning Tree**	Shows if STA has been enabled on this interface.
• **STA Status**	Displays current state of this port within the Spanning Tree:

	- Discarding Port receives STA configuration messages, but does not forward packets. **- Learning** Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses. **- Forwarding** Port forwards packets, and continues learning addresses.
• **Forward Transitions**	The number of times this port has transitioned from the Learning state to the Forwarding state.
• **Designated Cost**	The cost for a packet to travel from this port to the root in the current Spanning Tree configuration. The slower the media, the higher the cost.
• **Designated Bridge**	The bridge priority and MAC address of the device through which this port must communicate to reach the root of the Spanning Tree.
• **Designated Port**	The port priority and number of the port on the designated bridging device through which this switch must communicate with the root of the Spanning Tree.
• **Oper Path Cost**	The contribution of this port to the path cost of paths towards the spanning tree root which include this port.
• **Oper Link Type**	The operational point-to-point status of the LAN segment attached to this interface. This parameter is determined by manual configuration or by auto-detection, as described for Admin Link Type in STA Port Configuration.
• **Oper Edge Port**	This parameter is initialized to the setting for Admin Edge Port in STA Port Configuration (i.e., true or false), but will be set to false if a BPDU is received, indicating that another bridge is attached to this port.
• **Port Role**	Roles are assigned according to whether the port is part of the active topology connecting the bridge to the **root bridge** (i.e., root port), connecting a LAN through the bridge to the root bridge (i.e., designated port), or is the **MSTI regional root** (i.e., master port); or is an alternate or backup port that may provide connectivity if other bridges, bridge ports, or LANs fail or are removed. The role is set to disabled (i.e., disabled port) if a port has no role within the spanning tree.
• **Trunk Member**	Indicates if a port is a member of a trunk. (STA Port Information only)

4.7.1.4 STA Port Configuration

Configuring Interface Settings

You can configure RSTP and MSTP attributes for specific interfaces, including port priority, path cost, link type, and edge port. You may use a different priority or path cost for ports of the same media type to indicate the preferred path, link type to indicate a point-to-point connection or shared-media connection, and edge port to indicate if the attached device can support fast forwarding. (References to "**ports**" in this section means "interfaces," which includes both ports and trunks.)

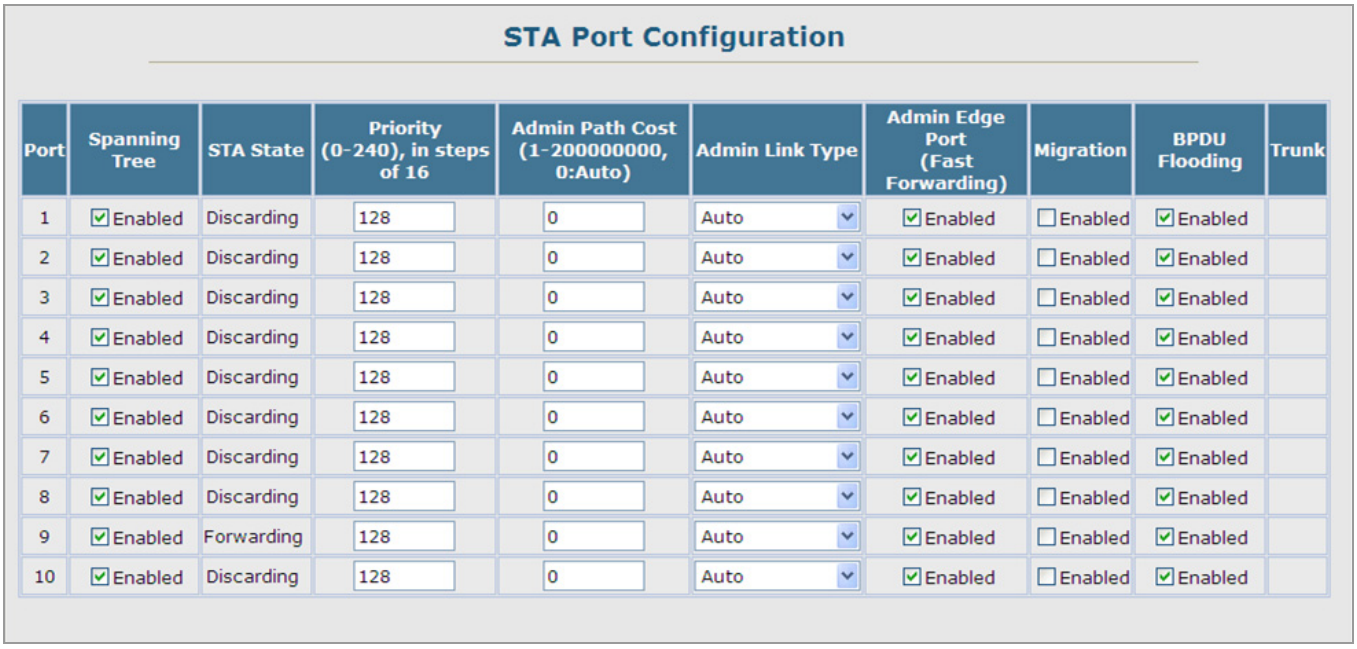

STA Port Configuration
Port
Spanning Tree
STA State
Priority (0-240), in steps of 16
Admin Path Cost (1-200000000, 0:Auto)
Admin Link Type
Admin Edge Port (Fast Forwarding)
Migration
BPDU Flooding
Trunk
1 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
2 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
3 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
4 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
5 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
6 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
7 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
8 Enabled Discarding 128 0 Auto Enabled Enabled Enabled
9 Enabled Forwarding 128 0 Auto Enabled Enabled Enabled
10 Enabled Discarding 128 0 Auto Enabled Enabled Enabled

Figure 4-7-7 STA Port Configuration page screenshot

The following attributes are read-only and cannot be changed:

Object	Description
• **STA State**	Displays current state of this port within the Spanning Tree. (See "Displaying Interface Settings" for additional information.) • **Discarding** - Port receives STA configuration messages, but does not forward packets. • **Learning** - Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses. • **Forwarding** -Port forwards packets, and continues learning addresses.
• **Trunk**	Indicates if a port is a member of a trunk. (STA Port Configuration only)
• **Spanning Tree**	Enables/disables STA on this interface. (Default: **Enabled**).

• **Priority**	Defines the priority used for this port in the Spanning Tree Protocol. If the path cost for all ports on a switch are the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Protocol is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled. Default: **128** Range: 0-240, in steps of 16
• **Admin Path Cost**	This parameter is used by the STA to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. (Path cost takes precedence over port priority.) (Range: 0 for auto-configuration, 1-65535 for the short path cost method11, 1-200,000,000 for the long path cost method)
• **Admin Link Type**	The link type attached to this interface. • **Point-to-Point** – A connection to exactly one other bridge. • **Shared** – A connection to two or more bridges. • **Auto** – The switch automatically determines if the interface is attached to a point-to-point link or to shared media. Default setting: **Auto**
• **Admin Edge Port (Fast Forwarding)**	You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes cannot cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device. (Default: **Disabled**)
• **Migration**	If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the Protocol Migration button to manually re-check the appropriate BPDU format (RSTP or STP-compatible) to send on the selected interfaces. (Default: **Disabled**)

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

Port Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Ethernet	50-600	200,000-20,000,000
Fast Ethernet	10-60	20,000-2,000,000
Gigabit Ethernet	3-10	2,000-200,000

Table 4-7-1 Recommended STA Path Cost Range

Port Type	Link Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Ethernet	Half Duplex	100	2,000,000
	Full Duplex	95	1,999,999
	Trunk	90	1,000,000
Fast Ethernet	Half Duplex	19	200,000
	Full Duplex	18	100,000
	Trunk	15	50,000
Gigabit Ethernet	Full Duplex	4	10,000
	Trunk	3	5,000

Table 4-7-2 Recommended STA Path Costs

Refer to "**Configuring Global Settings**" for information on setting the path cost method.

Port Type	Link Type	IEEE 802.1w-2001
Ethernet	Half Duplex	2,000,000
	Full Duplex	1,000,000
	Trunk	500,000
Fast Ethernet	Half Duplex	200,000
	Full Duplex	100,000
	Trunk	50,000
Gigabit Ethernet	Full Duplex	10,000
	Trunk	5,000

Table 4-7-3 Default STA Path Costs

4.7.2 MSTP

4.7.2.1 Configuring Multiple Spanning Trees

MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

By default all VLANs are assigned to the Internal Spanning Tree (MST Instance 0) that connects all bridges and LANs within the MST region. This switch supports up to 9 instances. You should try to group VLANs which cover the same general area of your network. However, remember that you must configure all bridges within the same MSTI Region with the same set of instances, and the same instance (on each bridge) with the same set of VLANs. Also, note that RSTP treats each MSTI region as a single node, connecting all regions to the Common Spanning Tree.

To use multiple spanning trees:

1. Set the spanning tree type to **MSTP** (STA Configuration).
2. Enter the spanning tree priority for the selected MST instance (MSTP VLAN Configuration).
3. Add the VLANs that will share this MSTI (MSTP VLAN Configuration).

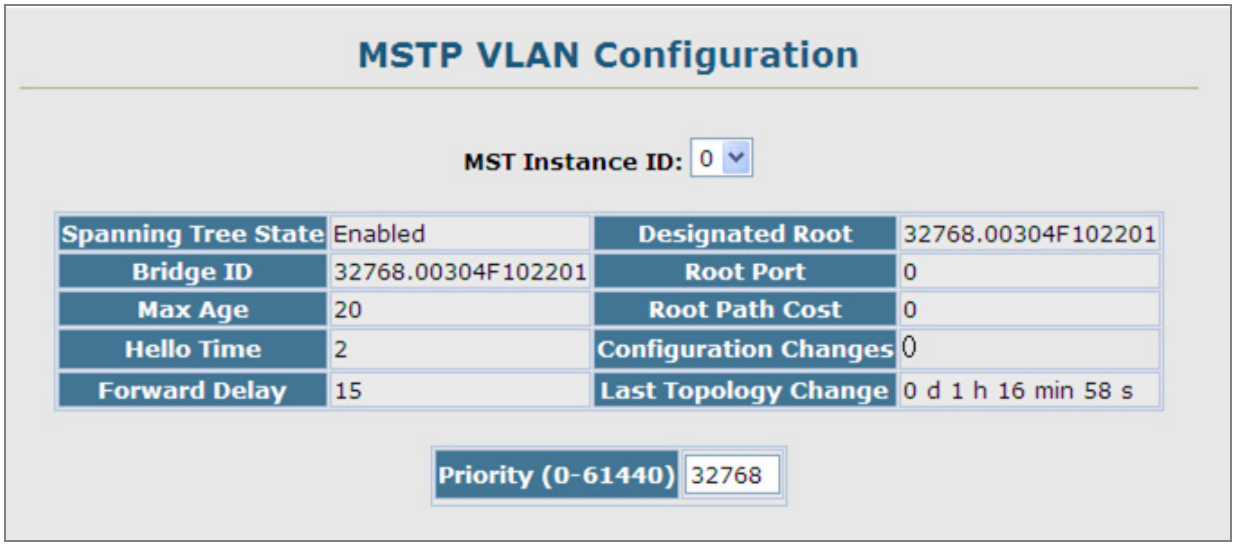


Figure 4-7-8 MSTP VLAN Configuration page screenshot

The page includes the following fields:

Object	Description
• **MST Instance**	Instance identifier of this spanning tree. (Default: **0**)
• **Priority**	The priority of a spanning tree instance. Range: **0-61440** in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480,

	24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440 Default: **32768**

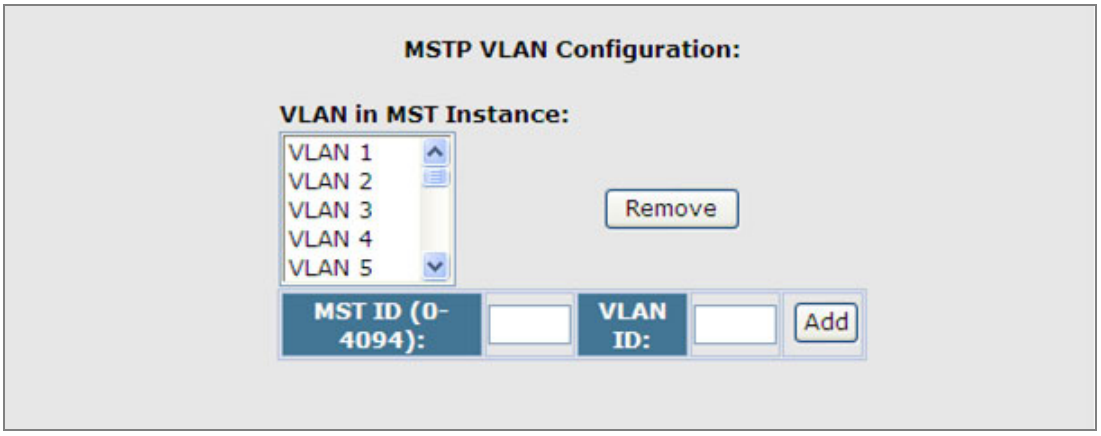


Figure 4-7-9 MSTP VLAN Configuration page screenshot

The page includes the following fields:

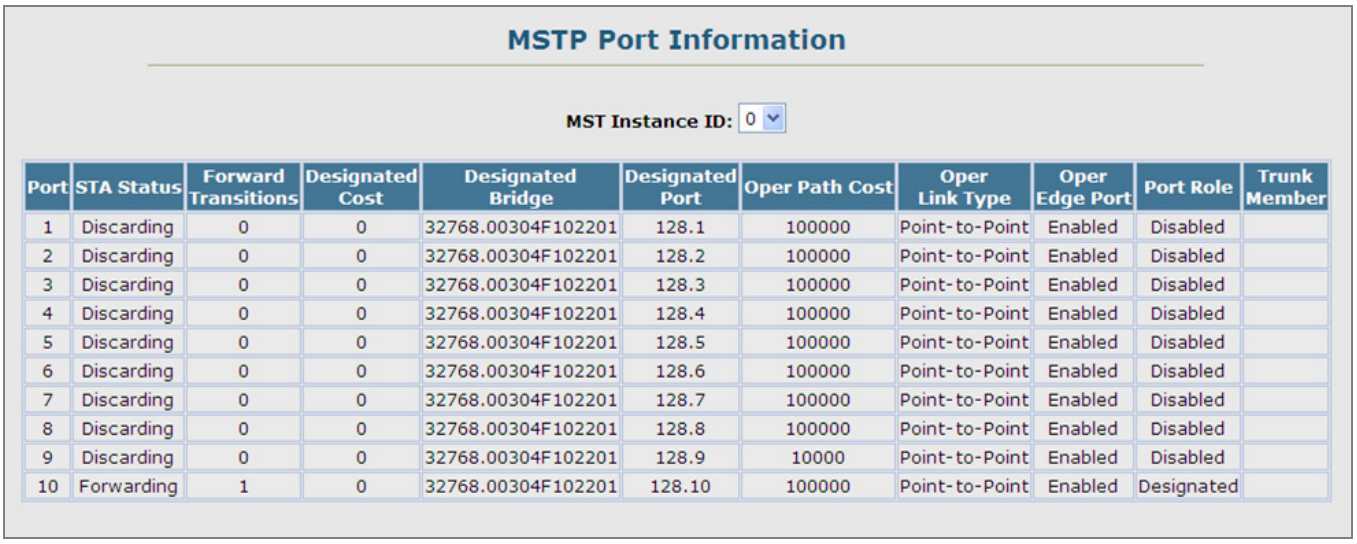
• **VLANs in MST Instance**	VLANs assigned to this instance.
• **MST ID**	Instance identifier to configure. (Range: 0-57; Default: **0**)
• **VLAN ID**	VLAN to assign to this selected MST instance. (Range: **1-4094**)

Note

1. All VLANs are automatically added to the IST (**Instance 0**).
2. To ensure that the MSTI maintains connectivity across the network, you must configure a related set of bridges with the **same MSTI settings**.

4.7.2.2 Displaying Interface Settings for MSTP

The MSTP Port Information and MSTP Trunk Information pages display the current status of ports and trunks in the selected MST instance.



MSTP Port Information

MST Instance ID: 0

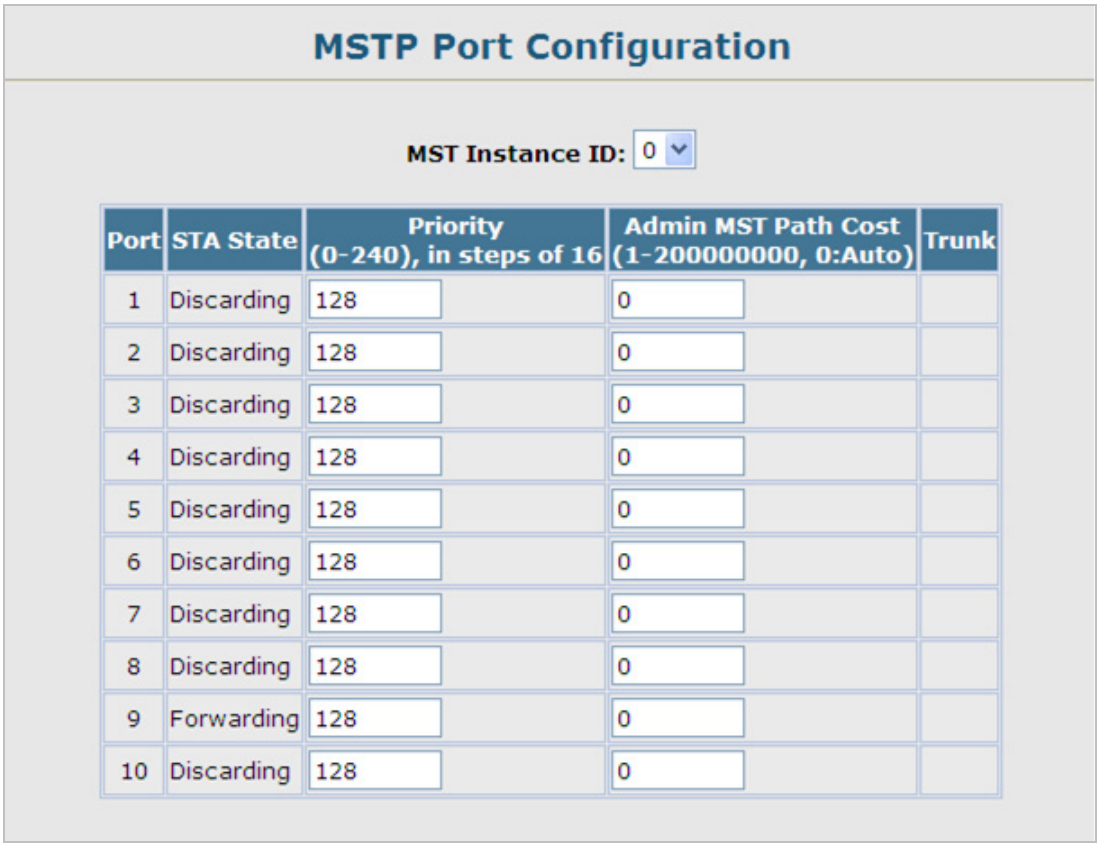
Port	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Path Cost	Oper Link Type	Oper Edge Port	Port Role	Trunk Member
1	Discarding	0	0	32768.00304F102201	128.1	100000	Point-to-Point	Enabled	Disabled	
2	Discarding	0	0	32768.00304F102201	128.2	100000	Point-to-Point	Enabled	Disabled	
3	Discarding	0	0	32768.00304F102201	128.3	100000	Point-to-Point	Enabled	Disabled	
4	Discarding	0	0	32768.00304F102201	128.4	100000	Point-to-Point	Enabled	Disabled	
5	Discarding	0	0	32768.00304F102201	128.5	100000	Point-to-Point	Enabled	Disabled	
6	Discarding	0	0	32768.00304F102201	128.6	100000	Point-to-Point	Enabled	Disabled	
7	Discarding	0	0	32768.00304F102201	128.7	100000	Point-to-Point	Enabled	Disabled	
8	Discarding	0	0	32768.00304F102201	128.8	100000	Point-to-Point	Enabled	Disabled	
9	Discarding	0	0	32768.00304F102201	128.9	10000	Point-to-Point	Enabled	Disabled	
10	Forwarding	1	0	32768.00304F102201	128.10	100000	Point-to-Point	Enabled	Designated	

Figure 4-7-10 MSTP Port Information page screenshot

4.7.2.3 MSTP Port Configuration

Configuring Interface Settings for MSTP

You can configure the STA interface settings for an MST Instance using the MSTP Port Configuration and MSTP Trunk Configuration pages.



MSTP Port Configuration

MST Instance ID: 0

Port	STA State	Priority (0-240), in steps of 16	Admin MST Path Cost (1-200000000, 0:Auto)	Trunk
1	Discarding	128	0	
2	Discarding	128	0	
3	Discarding	128	0	
4	Discarding	128	0	
5	Discarding	128	0	
6	Discarding	128	0	
7	Discarding	128	0	
8	Discarding	128	0	
9	Forwarding	128	0	
10	Discarding	128	0	

Figure 4-7-11 MSTP Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **STA State**	Displays current state of this port within the Spanning Tree. (See "Displaying Interface Settings" on page 3-156 for additional information.) -**Discarding** – Port receives STA configuration messages, but does not forward packets. -**Learning** – Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses. -**Forwarding** – Port forwards packets, and continues learning addresses.
• **Trunk**	Indicates if a port is a member of a trunk. (STA Port Configuration only)
• **MST Instance ID**	Instance identifier to configure. (Default: **0**)
• **Priority**	Defines the priority used for this port in the Spanning Tree Protocol. If the path cost for all ports on a switch are the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Protocol is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled. Range: 0-240, in steps of 16; Default: **128**
• **Admin MST Path Cost**	This parameter is used by the MSTP to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. (Path cost takes precedence over port priority.) Note that when the Path Cost Method is set to short, the maximum path cost is 65,535.

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "**0**" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to **65,535**.

4.8 VLAN Configuration

VLAN Description

A Virtual Local Area Network (VLAN) is a network topology configured according to a logical scheme rather than the physical layout. VLAN can be used to combine any collection of LAN segments into an autonomous user group that appears as a single LAN. VLAN also logically segment the network into different broadcast domains so that packets are forwarded only between ports within the VLAN. Typically, a VLAN corresponds to a particular subnet, although not necessarily.

VLAN can enhance performance by conserving bandwidth, and improve security by limiting traffic to specific domains.

A VLAN is a collection of end nodes grouped by logic instead of physical location. End nodes that frequently communicate with each other are assigned to the same VLAN, regardless of where they are physically on the network. Logically, a VLAN can be equated to a broadcast domain, because broadcast packets are forwarded to only members of the VLAN on which the broadcast was initiated.

1. No matter what basis is used to uniquely identify end nodes and assign these nodes VLAN membership, packets cannot cross VLAN without a network device performing a routing function between the VLAN.
2. The Managed Switch supports IEEE 802.1Q VLAN. The port untagging function can be used to remove the 802.1 tag from packet headers to maintain compatibility with devices that are tag-unaware.
3. The Switch's default is to assign all ports to a single 802.1Q VLAN named DEFAULT_VLAN. As new VLAN is created, the member ports assigned to the new VLAN will be removed from the DEFAULT_ VLAN port member list. The DEFAULT_VLAN has a VID = 1.

This section has the following items:

- **IEEE 802.1Q VLAN** — Enable IEEE 802.1Q Tag based VLAN group
- **GVRP Status** — Enables GVRP on the switch
- **IEEE 802.1Q Tunneling** — Enables 802.1Q (QinQ) Tunneling
- **Private VLAN** — Creates/removes primary or community VLANs
- **Protocol VLAN** — Creates a protocol group, specifying the supported protocols

4.8.1 IEEE 802.1Q VLANs

In large networks, routers are used to isolate broadcast traffic for each subnet into separate domains. This Managed Switch provides a similar service at Layer 2 by using VLANs to organize any group of network nodes into separate broadcast domains. VLANs confine broadcast traffic to the originating group, and can eliminate broadcast storms in large networks. This also provides a more secure and cleaner network environment.

An IEEE 802.1Q VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment.

VLANs help to simplify network management by allowing you to move devices to a new VLAN without having to change any physical connections. VLANs can be easily organized to reflect departmental groups (such as Marketing or R&D), usage groups (such as e-mail), or multicast groups (used for multimedia applications such as videoconferencing).

VLANs provide greater network efficiency by reducing broadcast traffic, and allow you to make network changes without having to update IP addresses or IP subnets. VLANs inherently provide a high level of network security since traffic must pass through a configured Layer 3 link to reach a different VLAN.

This Managed Switch supports the following VLAN features:

- Up to 255 VLANs based on the IEEE 802.1Q standard
- Distributed VLAN learning across multiple switches using explicit or implicit tagging and GVRP protocol
- Port overlapping, allowing a port to participate in multiple VLANs
- End stations can belong to multiple VLANs
- Passing traffic between VLAN-aware and VLAN-unaware devices
- Priority tagging

1. The Managed Switch allows 255 user-manageable VLANs.
2. One other VLAN (VLAN ID 4093) is reserved for switch clustering.

IEEE 802.1Q Standard

IEEE 802.1Q (tagged) VLAN are implemented on the Switch. 802.1Q VLAN require tagging, which enables them to span the entire network (assuming all switches on the network are IEEE 802.1Q-compliant).

VLAN allow a network to be segmented in order to reduce the size of broadcast domains. All packets entering a VLAN will only be forwarded to the stations (over IEEE 802.1Q enabled switches) that are members of that VLAN, and this includes broadcast, multicast and unicast packets from unknown sources.

VLAN can also provide a level of security to your network. IEEE 802.1Q VLAN will only deliver packets between stations that are members of the VLAN. Any port can be configured as either tagging or untagging. The untagging feature of IEEE 802.1Q VLAN allows VLAN to work with legacy switches that don't recognize VLAN tags in packet headers. The tagging feature allows VLAN to span multiple 802.1Q-compliant switches through a single physical connection and allows Spanning Tree to be enabled on all

ports and work normally.

Any port can be configured as either tagging or untagging. The untagging feature of IEEE 802.1Q VLAN allow VLAN to work with legacy switches that don't recognize VLAN tags in packet headers. The tagging feature allows VLAN to span multiple 802.1Q-compliant switches through a single physical connection and allows Spanning Tree to be enabled on all ports and work normally.

Some relevant terms:

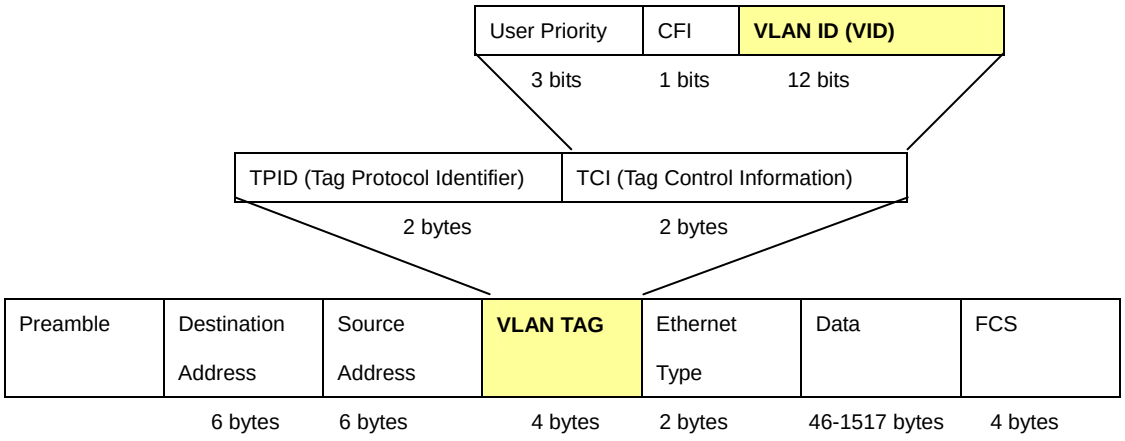
- **Tagging** - The act of putting 802.1Q VLAN information into the header of a packet.
- **Untagging** - The act of stripping 802.1Q VLAN information out of the packet header.

802.1Q VLAN Tags

The figure below shows the 802.1Q VLAN tag. There are four additional octets inserted after the source MAC address. Their presence is indicated by a value of **0x8100** in the Ether Type field. When a packet's Ether Type field is equal to 0x8100, the packet carries the IEEE 802.1Q/802.1p tag. The tag is contained in the following two octets and consists of 3 bits of user priority, 1 bit of Canonical Format Identifier (CFI - used for encapsulating Token Ring packets so they can be carried across Ethernet backbones), and 12 bits of **VLAN ID (VID)**. The 3 bits of user priority are used by 802.1p. The VID is the VLAN identifier and is used by the 802.1Q standard. Because the VID is 12 bits long, 4094 unique VLAN can be identified.

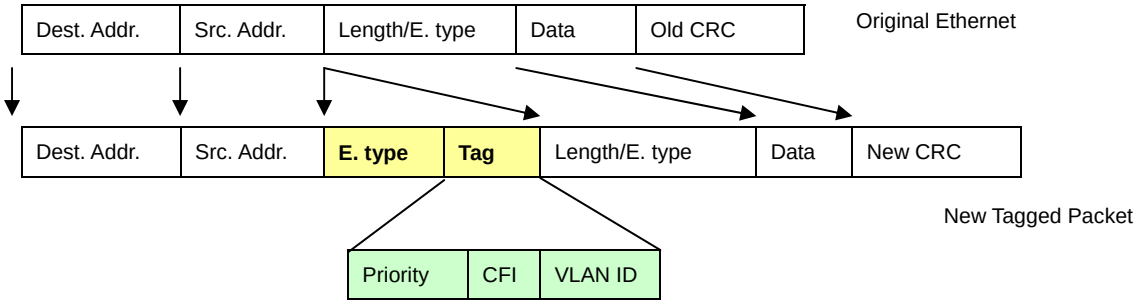
The tag is inserted into the packet header making the entire packet longer by 4 octets. All of the information originally contained in the packet is retained.

802.1Q Tag



The Ether Type and VLAN ID are inserted after the MAC source address, but before the original Ether Type/Length or Logical Link Control. Because the packet is now a bit longer than it was originally, the Cyclic Redundancy Check (CRC) must be recalculated.

Adding an IEEE802.1Q Tag



Port VLAN ID

Packets that are tagged (are carrying the 802.1Q VID information) can be transmitted from one 802.1Q compliant network device to another with the VLAN information intact. This allows 802.1Q VLAN to span network devices (and indeed, the entire network – if all network devices are 802.1Q compliant).

Every physical port on a switch has a PVID. 802.1Q ports are also assigned a PVID, for use within the switch. If no VLAN are defined on the switch, all ports are then assigned to a default VLAN with a PVID equal to 1. Untagged packets are assigned the PVID of the port on which they were received. Forwarding decisions are based upon this PVID, in so far as VLAN are concerned. Tagged packets are forwarded according to the VID contained within the tag. Tagged packets are also assigned a PVID, but the PVID is not used to make packet forwarding decisions, the VID is.

Tag-aware switches must keep a table to relate PVID within the switch to VID on the network. The switch will compare the VID of a packet to be transmitted to the VID of the port that is to transmit the packet. If the two VID are different the switch will drop the packet. Because of the existence of the PVID for untagged packets and the VID for tagged packets, tag-aware and tag-unaware network devices can coexist on the same network.

A switch port can have only one PVID, but can have as many VID as the switch has memory in its VLAN table to store them.

Because some devices on a network may be tag-unaware, a decision must be made at each port on a tag-aware device before packets are transmitted – should the packet to be transmitted have a tag or not? If the transmitting port is connected to a tag-unaware device, the packet should be untagged. If the transmitting port is connected to a tag-aware device, the packet should be tagged.

Default VLANs

The Switch initially configures one VLAN, VID = 1, called **"default."** The factory default setting assigns all ports on the Switch to the **"default"**. As new VLAN are configured in Port-based mode, their respective member ports are removed from the "default."

Assigning Ports to VLANs

Before enabling VLANs for the switch, you must first assign each port to the VLAN group(s) in which it will participate. By default all ports are assigned to VLAN 1 as untagged ports. Add a port as a tagged port if you want it to carry traffic for one or more

VLANs, and any intermediate network devices or the host at the other end of the connection supports VLANs. Then assign ports on the other VLAN-aware network devices along the path that will carry this traffic to the same VLAN(s), either manually or dynamically using GVRP. However, if you want a port on this switch to participate in one or more VLANs, but none of the intermediate network devices nor the host at the other end of the connection supports VLANs, then you should add this port to the VLAN as an untagged port.

VLAN-tagged frames can pass through VLAN-aware or VLAN-unaware network interconnection devices, but the VLAN tags should be stripped off before passing it on to any end-node host that does not support VLAN tagging.

VLAN Classification

When the switch receives a frame, it classifies the frame in one of two ways. If the frame is untagged, the switch assigns the frame to an associated VLAN (based on the default VLAN ID of the receiving port). But if the frame is tagged, the switch uses the tagged VLAN ID to identify the port broadcast domain of the frame.

Port Overlapping

Port overlapping can be used to allow access to commonly shared network resources among different VLAN groups, such as file servers or printers. Note that if you implement VLANs which do not overlap, but still need to communicate, you can connect them by enabled routing on this switch.

Untagged VLANs

Untagged (or static) VLANs are typically used to reduce broadcast traffic and to increase security. A group of network users assigned to a VLAN form a broadcast domain that is separate from other VLANs configured on the switch. Packets are forwarded only between ports that are designated for the same VLAN. Untagged VLANs can be used to manually isolate user groups or subnets. However, you should use IEEE 802.3 tagged VLANs with GVRP whenever possible to fully automate VLAN registration.

Automatic VLAN Registration

GVRP (GARP VLAN Registration Protocol) defines a system whereby the switch can automatically learn the VLANs to which each end station should be assigned. If an end station (or its network adapter) supports the IEEE 802.1Q VLAN protocol, it can be configured to broadcast a message to your network indicating the VLAN groups it wants to join. When this switch receives these messages, it will automatically place the receiving port in the specified VLANs, and then forward the message to all other ports. When the message arrives at another switch that supports GVRP, it will also place the receiving port in the specified VLANs, and pass the message on to all other ports. VLAN requirements are propagated in this way throughout the network. This allows GVRP-compliant devices to be automatically configured for VLAN groups based solely on endstation requests.
To implement GVRP in a network, first add the host devices to the required VLANs (using the operating system or other application software), so that these VLANs can be propagated onto the network. For both the edge switches attached directly to these hosts, and core switches in the network, enable GVRP on the links between these devices. You should also determine

security boundaries in the network and disable GVRP on the boundary ports to prevent advertisements from being propagated, or forbid those ports from joining restricted VLANs.

If you have host devices that do not support GVRP, you should configure static or untagged VLANs for the switch ports connected to these devices (as described in "Adding Static Members to VLANs (VLAN Index)"). But you can still enable GVRP on these edge switches, as well as on the core switches in the network.

VLAN and Link aggregation Groups

In order to use VLAN segmentation in conjunction with port link aggregation groups, you can first set the port link aggregation group(s), and then you may configure VLAN settings. If you wish to change the port link aggregation grouping with VLAN already in place, you will not need to reconfigure the VLAN settings after changing the port link aggregation group settings. VLAN settings will automatically change in conjunction with the change of the port link aggregation group settings

4.8.1.1 VLAN Basic Information

The VLAN Basic Information page displays basic information on the VLAN type supported by the Managed Switch.

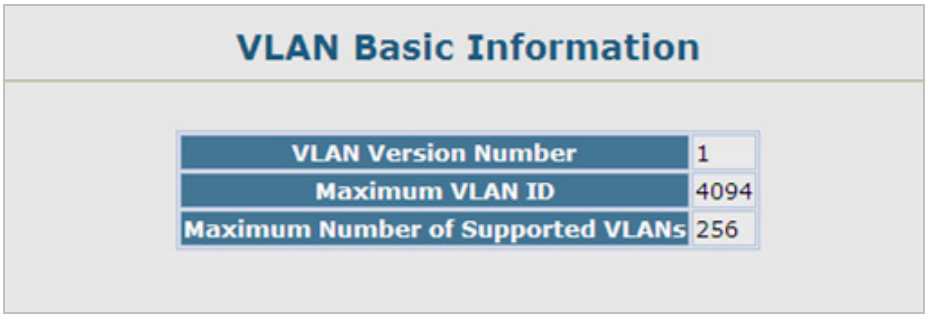


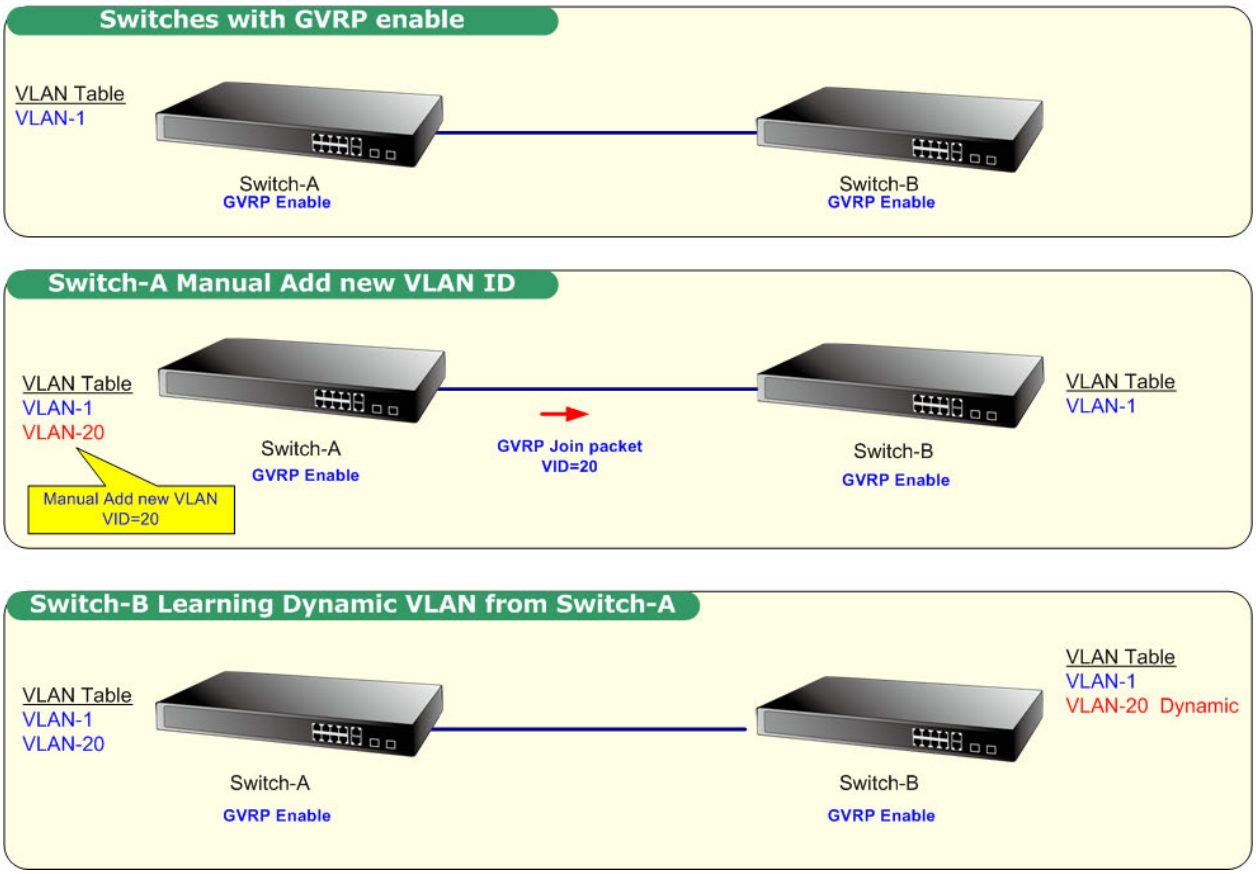
Figure 4-8-1 VLAN Basic Information page screenshot

The page includes the following fields:

Object	Description
• **VLAN Version Number**	The VLAN version used by this Managed Switch as specified in the IEEE 802.1Q standard.
• **Maximum VLAN ID**	Maximum VLAN ID recognized by this Managed Switch.
• **Maximum Number of Supported VLANs**	Maximum number of VLANs that can be configured on this Managed Switch.

4.8.1.2 GVRP Status

GARP VLAN Registration Protocol (GVRP) defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network.



VLANs are **dynamically** configured based on **join messages** issued by host devices and propagated throughout the network. GVRP must be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch.

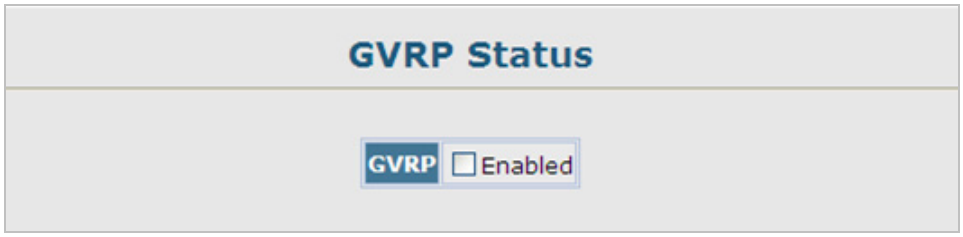


Figure 4-8-2 GVRP Status page screenshot

The page includes the following fields:

Object	Description
• **GVRP**	Enables and disables GVRP on the device (Default: **Disabled**)

4.8.1.3 VLAN Current Table

This page shows the current port members of each VLAN and whether or not the port supports VLAN tagging. Ports assigned to a large VLAN group that crosses several switches should use VLAN tagging. However, if you just want to create a small port-based VLAN for one or two switches, you can disable tagging.

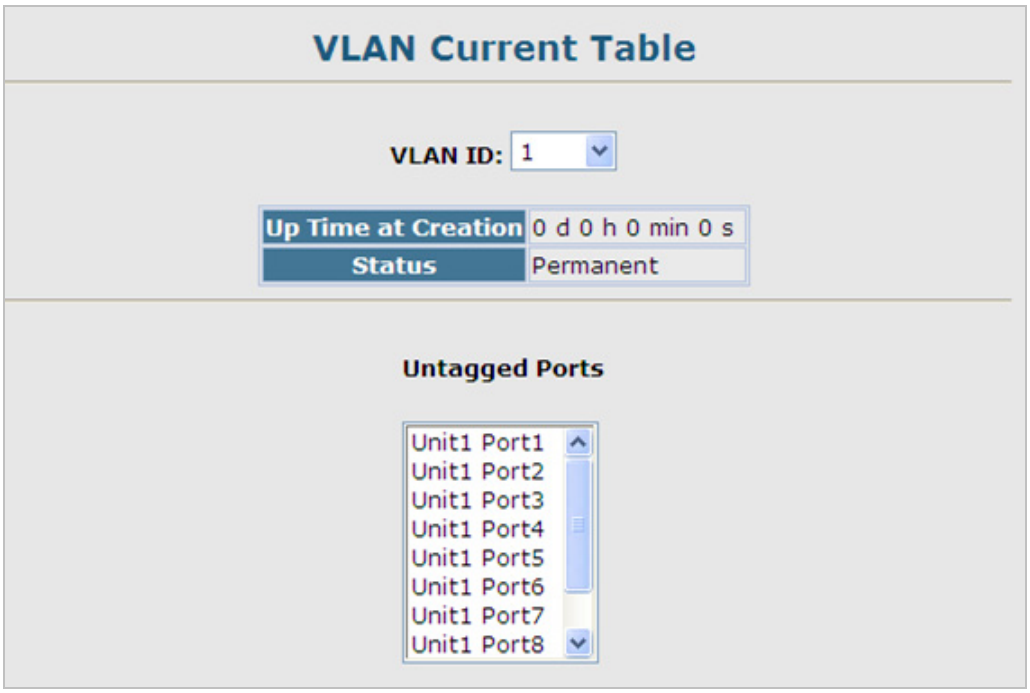


Figure 4-8-3 VLAN Current Table page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	ID of configured VLAN (1-4094).
• **Up Time at Creation**	Time this VLAN was created (i.e., System Up Time).
• **Status**	Shows how this VLAN was added to the switch. **- Permanent** Added as a static entry. **- Dynamic GVRP** Automatically learned via GVRP.
• **Egress Ports**	Shows the ports that have been added to the displayed VLAN group.
• **Untagged Ports**	Shows the untagged VLAN port members.

4.8.1.4 VLAN Static List

Creating VLANs

Use the VLAN Static List to create or remove VLAN groups. To propagate information about VLAN groups used on this Managed Switch to external network devices, you must specify a VLAN ID for each of these groups.

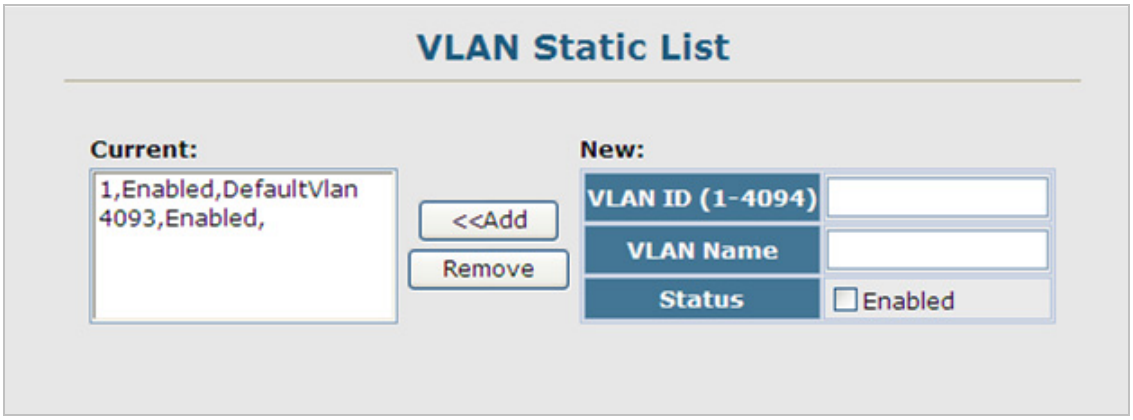


Figure 4-8-4 VLAN Static List page screenshot

The page includes the following fields:

Object	Description
• **Current**	Lists all the current VLAN groups created for this system. Up to **255** VLAN groups can be defined. **VLAN 1** is the **default untagged VLAN**. **VLAN 4093** is reserved for **switch clustering** and is not user-configurable or removable.
• **New**	Allows you to specify the name and numeric identifier for a new VLAN group. (The VLAN name is only used for management on this system; it is not added to the VLAN tag.)
• **VLAN ID**	ID of configured VLAN (**1-4094**, no leading zeroes).
• **VLAN Name**	Name of the VLAN (**1 to 32** characters, no spaces).
• **Status**	Enables or disables the specified VLAN. - **Enabled**: VLAN is operational. - **Disabled**: VLAN is suspended; i.e., does not pass packets.
• **Add**	Adds a new VLAN group to the current list.
• **Remove**	Removes a VLAN group from the current list. If any port is assigned to this group as untagged, it will be reassigned to VLAN group 1 as untagged.

4.8.1.5 VLAN Static Table

■ **Adding Static Members to VLANs (VLAN Index)**

Use the VLAN Static Table to configure port members for the selected VLAN index. Assign ports as tagged if they are connected to 802.1Q VLAN compliant devices, or untagged they are not connected to any VLAN-aware devices. Or configure a port as forbidden to prevent the Managed Switch from automatically adding it to a VLAN via the GVRP protocol.

■ **Understand nomenclature of the Switch**

Tagged and Untagged

Every port on an 802.1Q compliant switch can be configured as tagged or untagged.

- **Tagged:** Ports with tagging enabled will put the VID number, priority and other VLAN information into the header of all packets that flow into those ports. If a packet has previously been tagged, the port will not alter the packet, thus keeping the VLAN information intact. The VLAN information in the tag can then be used by other 802.1Q compliant devices on the network to make packet-forwarding decisions.
- **Untagged:** Ports with untagging enabled will strip the 802.1Q tag from all packets that flow into those ports. If the packet doesn't have an 802.1Q VLAN tag, the port will not alter the packet. Thus, all packets received by and forwarded by an untagging port will have no 802.1Q VLAN information. (Remember that the PVID is only used internally within the Switch). Untagging is used to send packets from an 802.1Q-compliant network device to a non-compliant network device.

Frame Income / Frame Leave	Income Frame is **tagged**	Income Frame is **untagged**
Leave port is tagged	Frame remains tagged	Tag is inserted
Leave port is untagged	Tag is removed	Frame remain untagged

Command Sequence –

1. Select a **VLAN ID** from the scroll-down list.
2. Modify the **VLAN name** and **status** if required.
3. Select the **membership type** by marking the appropriate radio button in the list of ports or trunks.
4. Click **Apply.**

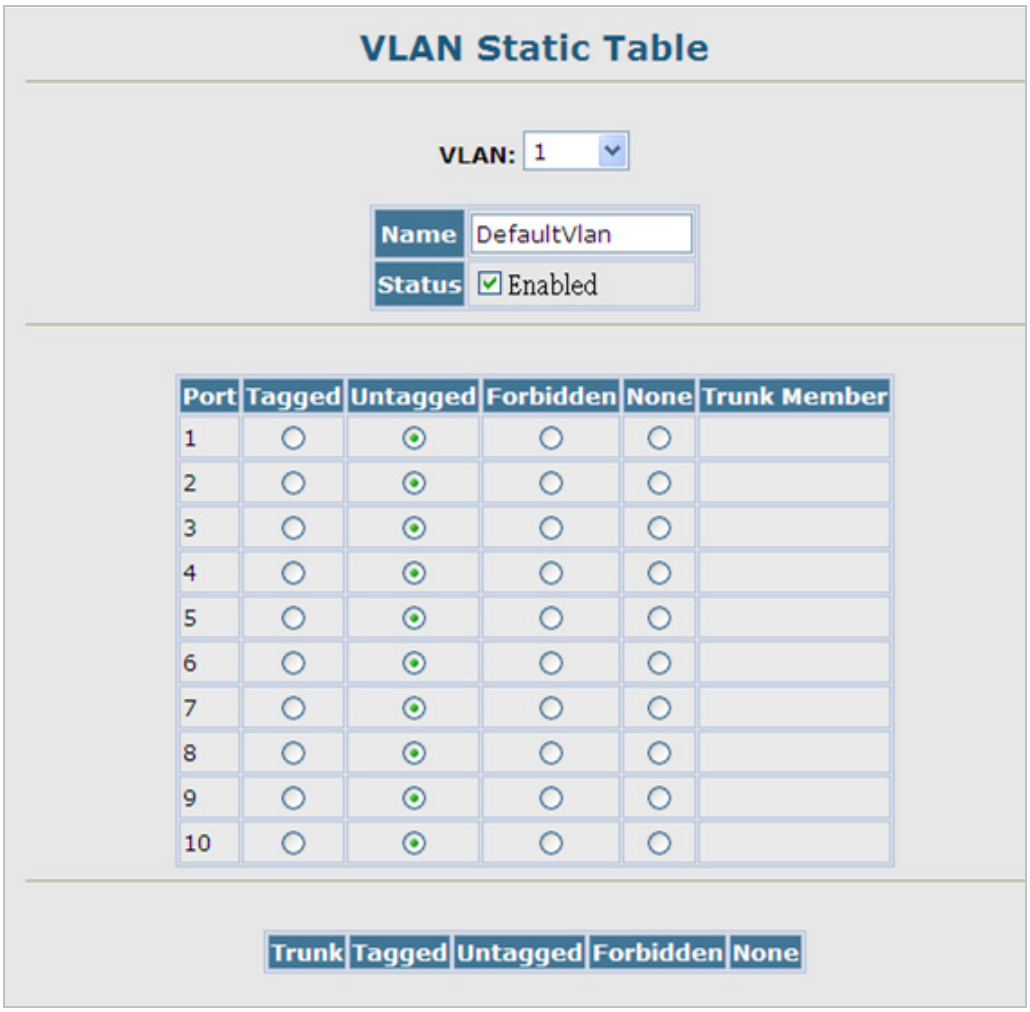


Figure 4-8-5 VLAN Static Table page screenshot

The page includes the following fields:

Object	Description	
VLAN	ID of configured VLAN. Range :**1-4093**, no leading zeros	
Name	Name of the VLAN. Range: **1 to 32** characters	
Status	Enables or disables the specified VLAN. -**Enable**: VLAN is operational. -**Disable**: VLAN is suspended; i.e., does not pass packets.	
Port	Port identifier.	
Membership Type	Select VLAN membership for each interface by marking the appropriate radio button for a port or trunk:	
	-Tagged:	Interface is a member of the VLAN. All packets transmitted by the port will be tagged, that is, carry a tag and therefore carry VLAN or CoS information.

	-Untagged:	Interface is a member of the VLAN. All packets transmitted by the port will be untagged, that is, not carry a tag and therefore not carry VLAN or CoS information. Note that an interface must be assigned to at least one group as an untagged port.
	-Forbidden:	Interface is forbidden from automatically joining the VLAN via GVRP. For more information, see "**Automatic VLAN Registration**".
	-None:	Interface is not a member of the VLAN. Packets associated with this VLAN will not be transmitted by the interface.
Trunk Member	Indicates if a port is a member of a trunk. To add a trunk to the selected VLAN, use the last table on the VLAN Static Table page.	

1. You can also use the VLAN Static Membership by Port page to configure VLAN groups based on the port index (**VLAN Static Membership by Port**). However, note that this configuration page can only add ports to a VLAN as tagged members.
2. VLAN 1 is the default untagged VLAN containing all ports on the switch, and can only be modified by first reassigning the default port VLAN ID. See **VLAN Port Configuration**.

4.8.1.6 Static Membership by Port

Adding Static Members to VLANs (Port Index)

Use this page to assign VLAN groups to the selected interface as a tagged member.

Command Sequence –

1. Select an **interface** from the scroll-down box (Port or Trunk).
2. Click **Query** to display membership information for the interface.
3. Select a **VLAN ID**, and then click **Add** to add the interface as a tagged member, or click **Remove** to remove the interface.
4. After configuring VLAN membership for each interface, click **Apply**.

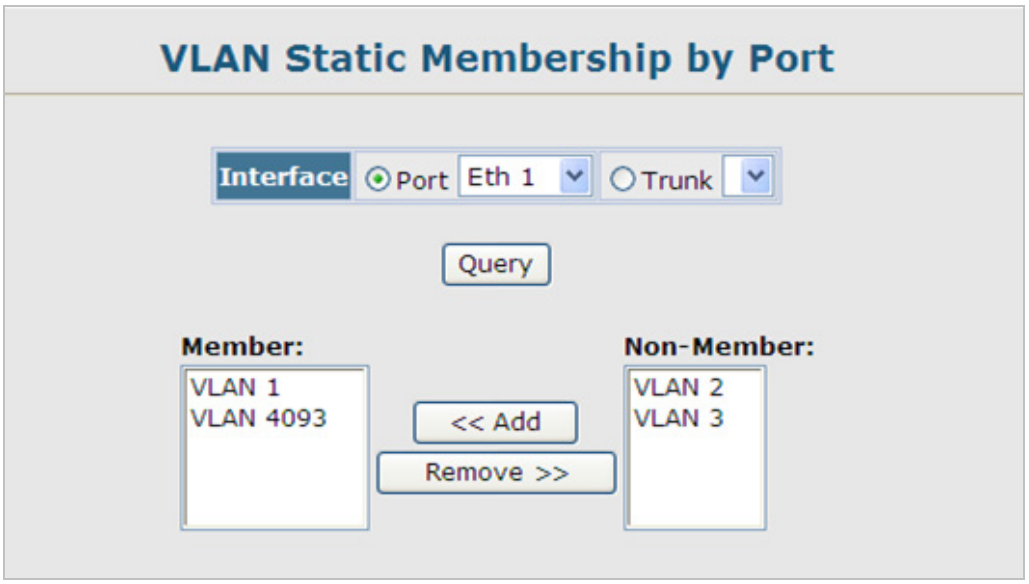


Figure 4-8-6 VLAN Static Membership by Port page screenshot

The page includes the following fields:

Object	Description
• **Interface**	Port or trunk identifier.
• **Query**	To display membership information for the interface
• **Member**	VLANs for which the selected interface is a tagged member.
• **Non-Member**	VLANs for which the selected interface is not a tagged member.

4.8.1.7 VLAN Port Configuration

Configuring VLAN Behavior for Interfaces

You can configure VLAN behavior for specific interfaces, including the default **VLAN identifier (PVID)**, **accepted frame types**, **ingress filtering**, **GVRP status**, and **GARP timers**.

- **GARP VLAN Registration Protocol (GVRP)** defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network.
- **Group Address Registration Protocol (GARP)** is used by GVRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GVRP registration/deregistration.

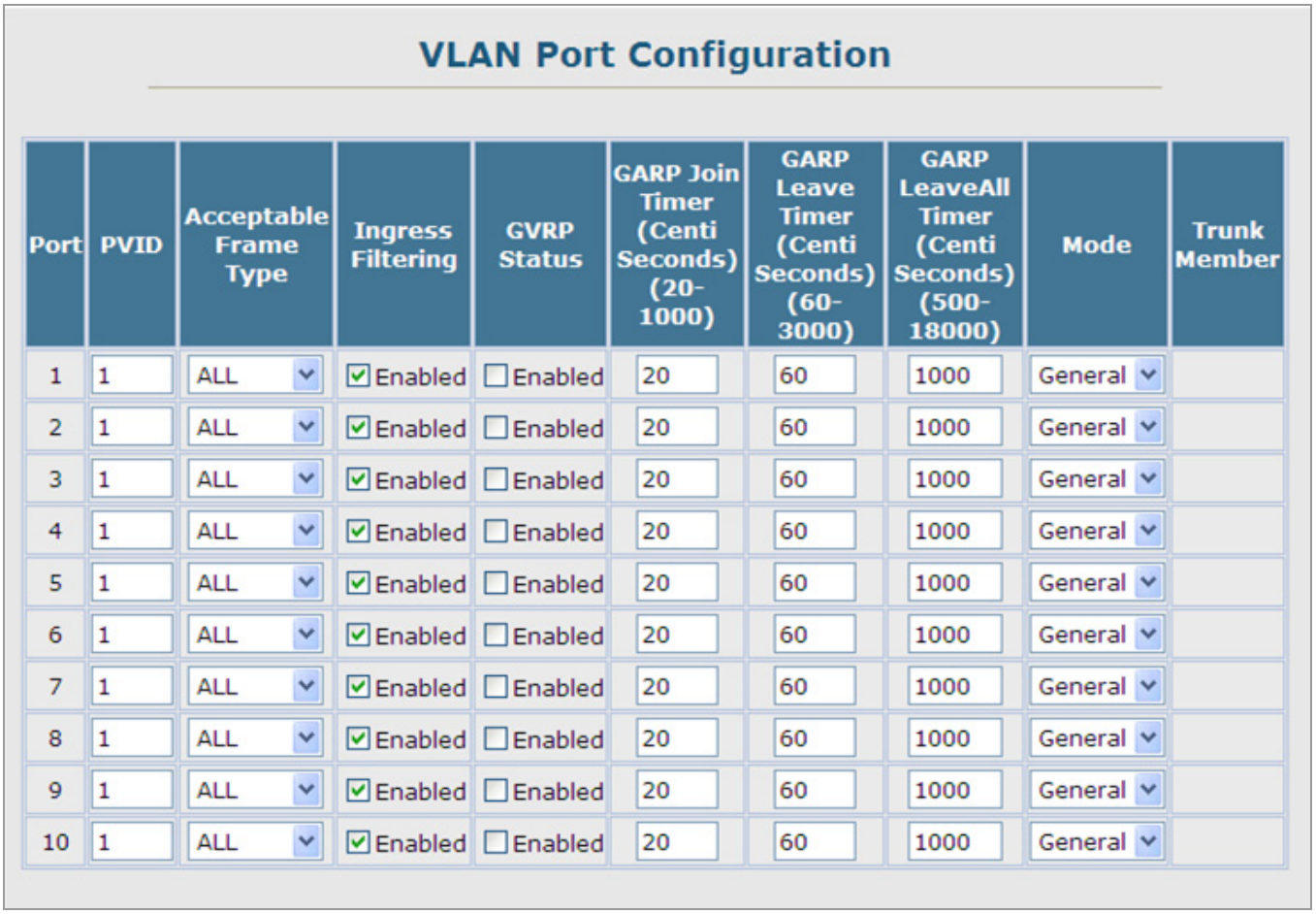

VLAN Port Configuration
Port
PVID
Acceptable Frame Type
Ingress Filtering
GVRP Status
GARP Join Timer (Centi Seconds) (20-1000)
GARP Leave Timer (Centi Seconds) (60-3000)
GARP LeaveAll Timer (Centi Seconds) (500-18000)
Mode
Trunk Member
1 1 ALL Enabled Enabled 20 60 1000 General
2 1 ALL Enabled Enabled 20 60 1000 General
3 1 ALL Enabled Enabled 20 60 1000 General
4 1 ALL Enabled Enabled 20 60 1000 General
5 1 ALL Enabled Enabled 20 60 1000 General
6 1 ALL Enabled Enabled 20 60 1000 General
7 1 ALL Enabled Enabled 20 60 1000 General
8 1 ALL Enabled Enabled 20 60 1000 General
9 1 ALL Enabled Enabled 20 60 1000 General
10 1 ALL Enabled Enabled 20 60 1000 General

Figure 4-8-7 VLAN Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **PVID**	**VLAN ID** assigned to **untagged** frames received on the interface. (Default: **1**) If an interface is not a member of VLAN 1 and you assign its PVID to this VLAN, the interface will automatically be added to VLAN 1 as an untagged member. For all other VLANs, the PVID must be defined first, then the status of the VLAN can be configured as a tagged or untagged member.
• **Acceptable Frame Type**	Sets the interface to accept all frame types, including tagged or untagged frames, or only tagged frames. Options: ■ **All** ■ **Tagged** When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN. (Default: **All)**
• **Ingress Filtering**	Determines how to process frames tagged for VLANs for which the ingress port is not a member. Ingress Filtering is always enabled. (Default: **Enabled**) - Ingress filtering only affects **tagged** frames. - If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port). - If ingress filtering is enabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be discarded. -Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STP. However, they do affect VLAN dependent BPDU frames, such as GMRP.
• **GVRP Status**	Enables/disables GVRP for the interface. GVRP must be globally enabled for the switch before this setting can take effect. (**See "GVRP Status(Global Setting)"**.) When disabled, any GVRP packets received on this port will be discarded and no GVRP registrations will be propagated from other ports. (Default: **Disabled**)
• **GARP Join Timer***	The interval between transmitting requests/queries to participate in a VLAN group. Range: 20-1000 centiseconds Default: **20** centiseconds

• **GARP Leave Timer***	The interval a port waits before leaving a VLAN group. This time should be set to more than twice the join time. This ensures that after a Leave or LeaveAll message has been issued, the applicants can rejoin before the port actually leaves the group. Range: 60-3000 centiseconds Default: **60** centiseconds
• **GARP LeaveAll Timer***	The interval between sending out a LeaveAll query message for VLAN group participants and the port leaving the group. This interval should be considerably larger than the Leave Time to minimize the amount of traffic generated by nodes rejoining the group. Range: 500-18000 centiseconds; Default: **1000** centiseconds
• **Mode**	Indicates VLAN membership mode for an interface. - **Access** - Sets the port to operate as an untagged interface. All frames are sent untagged. - **General** – Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames. - **Trunk** - Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. Note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are also transmitted as tagged frames. Default: **General**
• **Trunk Member**	Indicates if a port is a member of a trunk. To add a trunk to the selected VLAN, use the last table on the VLAN Static Table page.

Timer settings must follow this rule:

2 x (join timer) < leave timer < leaveAll timer

4.8.2 Q-in-Q VLAN

IEEE 802.1Q Tunneling (Q-in-Q)

IEEE 802.1Q Tunneling (QinQ) is designed for service providers carrying traffic for multiple customers across their networks. QinQ tunneling is used to maintain customer-specific VLAN and Layer 2 protocol configurations even when different customers use the same internal VLAN IDs. This is accomplished by inserting **Service Provider VLAN (SPVLAN)** tags into the customer's frames when they enter the service provider's network, and then stripping the tags when the frames leave the network.

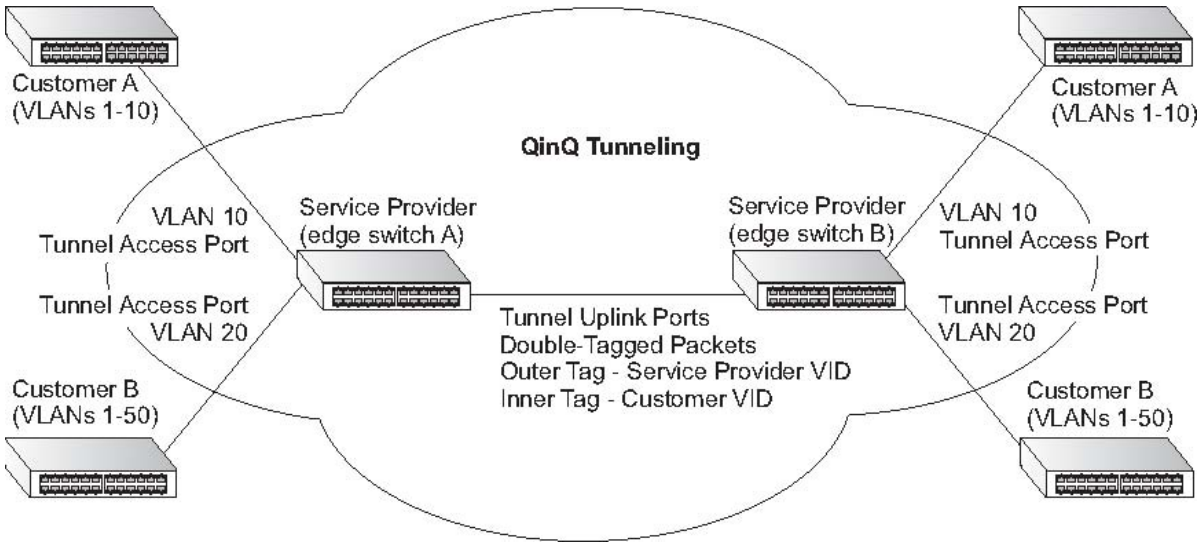
A service provider's customers may have specific requirements for their internal VLAN IDs and number of VLANs supported. VLAN ranges required by different customers in the same service-provider network might easily overlap, and traffic passing through the infrastructure might be mixed. Assigning a unique range of VLAN IDs to each customer would restrict customer configurations, require intensive processing of VLAN mapping tables, and could easily exceed the maximum VLAN limit of 4096.

QinQ tunneling uses a **single Service Provider VLAN (SPVLAN)** for customers who have multiple VLANs. Customer VLAN IDs are preserved and traffic from different customers is segregated within the service provider's network even when they use the same customer-specific VLAN IDs. QinQ tunneling expands VLAN space by using a VLAN-in-VLAN hierarchy, preserving the customer's original tagged packets, and adding **SPVLAN tags** to each frame (also called **double tagging**).

A port configured to support QinQ tunneling must be set to tunnel port mode. The **Service Provider VLAN (SPVLAN)** ID for the specific customer must be assigned to the QinQ tunnel access port on the edge switch where the customer traffic enters the service provider's network. Each customer requires a separate SPVLAN, but this VLAN supports all of the customer's internal VLANs. The QinQ tunnel uplink port that passes traffic from the edge switch into the service provider's metro network must also be added to this SPVLAN. The uplink port can be added to multiple SPVLANs to carry inbound traffic for different customers onto the service provider's network.

When a double-tagged packet enters another trunk port in an intermediate or core switch in the service provider's network, the outer tag is stripped for packet processing. When the packet exits another trunk port on the same core switch, the same SPVLAN tag is again added to the packet.

When a packet enters the trunk port on the service provider's egress switch, the outer tag is again stripped for packet processing. However, the SPVLAN tag is not added when it is sent out the tunnel access port on the edge switch into the customer's network. The packet is sent as a normal IEEE 802.1Q-tagged frame, preserving the original VLAN numbers used in the customer's network.



Layer 2 Flow for Packets Coming into a Tunnel Access Port

A QinQ tunnel port may receive either tagged or untagged packets. No matter how many tags the incoming packet has, it is treated as tagged packet.

The ingress process does source and destination lookups. If both lookups are successful, the ingress process writes the packet to memory. Then the egress process transmits the packet. Packets entering a QinQ tunnel port are processed in the following manner:

1. New SPVLAN tags are added to all incoming packets, no matter how many tags they already have. The ingress process constructs and inserts the outer tag (SPVLAN) into the packet based on the default VLAN ID and Tag Protocol Identifier (TPID, that is, the ether-type of the tag). This outer tag is used for learning and switching packets. The priority of the inner tag is copied to the outer tag if it is a tagged or priority tagged packet.

2. After successful source and destination lookup, the ingress process sends the packet to the switching process with two tags. If the incoming packet is untagged, the outer tag is an SPVLAN tag, and the inner tag is a dummy tag (8100 0000). If the incoming packet is tagged, the outer tag is an SPVLAN tag, and the inner tag is a CVLAN tag.

3. After packet classification through the switching process, the packet is written to memory with one tag (an outer tag) or with two tags (both an outer tag and inner tag).

4. The switch sends the packet to the proper egress port.

5. If the egress port is an untagged member of the SPVLAN, the outer tag will be stripped. If it is a tagged member, the outgoing packets will have two tags.

Layer 2 Flow for Packets Coming into a Tunnel Uplink Port

An uplink port receives one of the following packets:

- Untagged
- One tag (CVLAN or SPVLAN)
- Double tag (CVLAN + SPVLAN)

The ingress process does source and destination lookups. If both lookups are successful, the ingress process writes the packet

to memory. Then the egress process transmits the packet. Packets entering a QinQ uplink port are processed in the following manner:

1. If incoming packets are untagged, the PVID VLAN native tag is added.
2. If the ether-type of an incoming packet (single or double tagged) is not equal to the TPID of the uplink port, the VLAN tag is determined to be a **Customer VLAN (CVLAN)** tag. The uplink port's PVID VLAN native tag is added to the packet. This outer tag is used for learning and switching packets within the service provider's network. The TPID must be configured on a per port basis, and the verification cannot be disabled.
3. If the ether-type of an incoming packet (single or double tagged) is equal to the TPID of the uplink port, no new VLAN tag is added. If the uplink port is not the member of the outer VLAN of the incoming packets, the packet will be dropped when ingress filtering is enabled. If ingress filtering is not enabled, the packet will still be forwarded. If the VLAN is not listed in the VLAN table, the packet will be dropped.
4. After successful source and destination lookups, the packet is double tagged. The Managed Switch uses the TPID of **0x8100** to indicate that an incoming packet is double-tagged. If the outer tag of an incoming double-tagged packet is equal to the port TPID and the inner tag is 0x8100, it is treated as a double-tagged packet. If a single-tagged packet has 0x8100 as its TPID, and port TPID is not 0x8100, a new VLAN tag is added and it is also treated as double-tagged packet.
5. If the destination address lookup fails, the packet is sent to all member ports of the outer tag's VLAN.
6. After packet classification, the packet is written to memory for processing as a single-tagged or double-tagged packet.
7. The switch sends the packet to the proper egress port.
8. If the egress port is an untagged member of the SPVLAN, the outer tag will be stripped. If it is a tagged member, the outgoing packet will have two tags.

Configuration Limitations for QinQ

- The native VLAN of uplink ports should not be used as the SPVLAN. If the SPVLAN is the uplink port's native VLAN, the uplink port must be an untagged member of the SPVLAN. Then the outer SPVLAN tag will be stripped when the packets are sent out. Another reason is that it causes non-customer packets to be forwarded to the SPVLAN.
- Static trunk port groups are compatible with QinQ tunnel ports as long as the QinQ configuration is consistent within a trunk port group.
- The native VLAN (VLAN 1) is not normally added to transmitted frames. Avoid using VLAN 1 as an SPVLAN tag for customer traffic to reduce the risk of misconfiguration. Instead, use VLAN 1 as a management VLAN instead of a data VLAN in the service provider network.
- There are some inherent incompatibilities between Layer 2 and Layer 3 switching:
  -Tunnel ports do not support IP Access Control Lists.
  -Layer 3 Quality of Service (QoS) and other QoS features containing Layer 3 information are not supported on tunnel ports.
  -Spanning tree bridge protocol data unit (BPDU) filtering is automatically disabled on a tunnel port.

General Configuration Guidelines for QinQ

1. Configure the switch to QinQ mode (see "Enabling QinQ Tunneling on the Switch").
2. Set the Tag Protocol Identifier (TPID) value of the tunnel access port. This step is required if the attached client is using a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The default ethertype value is 0x8100. (See "Adding an

Interface to a QinQ Tunnel" on page 3-185.)

3. Create a Service Provider VLAN, also referred to as an SPVLAN (see "Creating VLANs").
4. Configure the QinQ tunnel access port to 802.1Q Tunnel mode (see "Adding an Interface to a QinQ Tunnel").
5. Configure the QinQ tunnel access port to join the SPVLAN as an untagged member (see "Adding Static Members to VLANs (VLAN Index)").
6. Configure the SPVLAN ID as the native VID on the QinQ tunnel access port (see "Configuring VLAN Behavior for Interfaces").
7. Configure the QinQ tunnel uplink port to 802.1Q Tunnel Uplink mode (see "Adding an Interface to a QinQ Tunnel").
8. Configure the QinQ tunnel uplink port to join the SPVLAN as a tagged member (see "Adding Static Members to VLANs (VLAN Index)" on page 3-176).

4.8.2.1 802.1Q Tunnel Configuration

Enabling QinQ Tunneling on the Switch

The Managed Switch can be configured to operate in normal VLAN mode or IEEE 802.1Q (QinQ) tunneling mode which is used for passing Layer 2 traffic across a service provider's metropolitan area network.

Figure 4-8-8 802.1Q Tunnel Configuration page screenshot

The page includes the following fields:

Object	Description
• **802.1Q Tunnel Status**	Sets the Managed Switch to **QinQ** mode, and allows the QinQ tunnel port to be configured. The default is for the Managed Switch to function in normal mode.

4.8.2.2 802.1Q Tunnel Port Configuration

Adding an Interface to a QinQ Tunnel

Follow the guidelines in the preceding section to set up a QinQ tunnel on the Managed Switch. Use the VLAN Port Configuration or VLAN Trunk Configuration screen to set the access port on the edge switch to 802.1Q Tunnel mode. Also set the **Tag Protocol Identifier (TPID)** value of the tunnel port if the attached client is using a nonstandard 2-byte ethertype to identify 802.1Q tagged frames.

Command Usage:

- Use the **802.1Q Tunnel Configuration** screen to set the Managed Switch to **QinQ mode** before configuring a tunnel port (see "**Enabling QinQ Tunneling on the Switch**").
- Use the TPID field to set a custom 802.1Q ethertype value on the selected interface. This feature allows the switch to interoperate with third-party switches that do not use the standard 0x8100 ethertype to identify 802.1Q-tagged frames. For example, if 0x1234 is set as the custom 802.1Q ethertype on a trunk port, incoming frames containing that ethertype are assigned to the VLAN contained in the tag following the ethertype field, as they would be with a standard 802.1Q trunk. Frames arriving on the port containing any other ethertype are looked upon as untagged frames, and assigned to the native VLAN of that port.
- All ports on the switch will be set to the same ethertype.

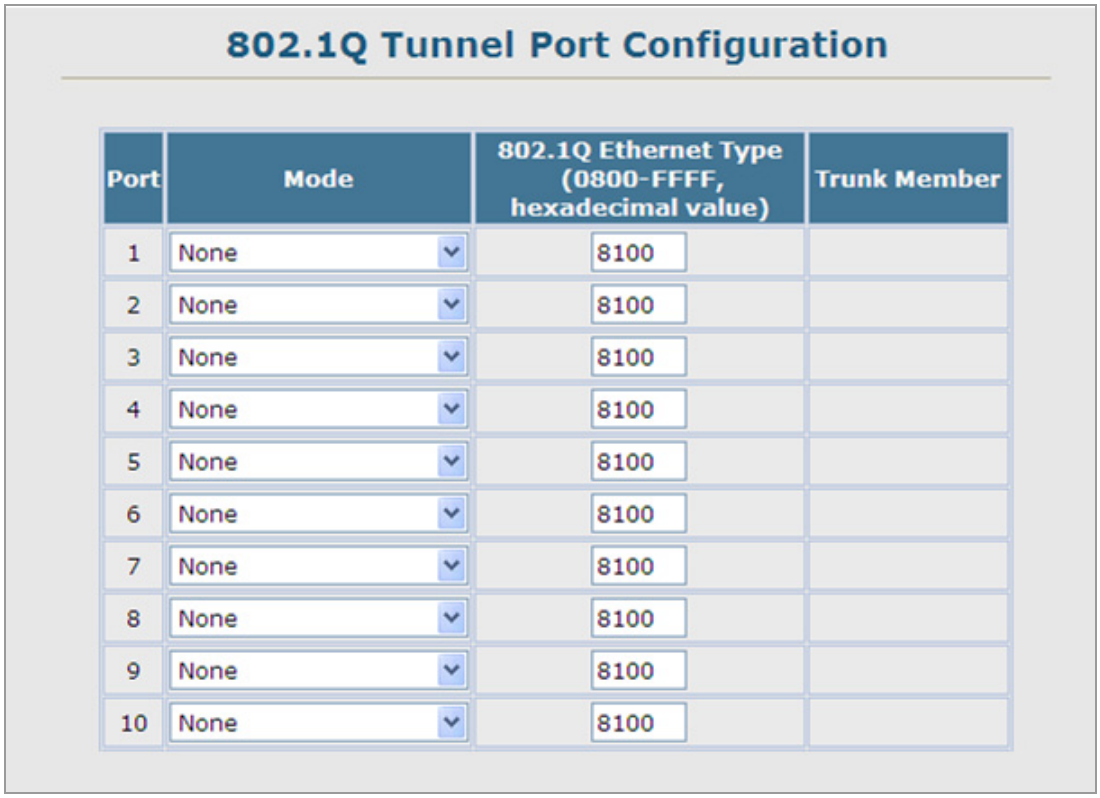


Figure 4-8-9.802.1Q Tunnel Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Port**	Port number.
• **Mode**	Set the VLAN membership mode of the port. • **None** The port operates in its normal VLAN mode. (This is the default.) • **802.1Q Tunnel** Configures IEEE 802.1Q tunneling (QinQ) for a client access port to segregate and preserve customer VLAN IDs for traffic crossing the service provider network. • **802.1Q Tunnel Uplink** Configures IEEE 802.1Q tunneling (QinQ) for an uplink port to another device within the service provider network. Default: **None**
• **802.1Q Ethernet Type**	The **Tag Protocol Identifier (TPID)** specifies the ethertype of incoming packets on a tunnel access port. Range: 0800-FFFF hexadecimal (Default: **8100**)
• **Trunk Member**	Shows if a port is a member or a trunk.

If you have host devices that do not support GVRP, you should configure static or untagged VLANs for the switch ports connected to these devices But you can still enable GVRP on these edge switches, as well as on the core switches in the network.

4.8.3 Private VLAN

Private VLANs provide port-based security and isolation between ports within the assigned VLAN. This Managed Switch supports two types of private VLANs:

- **primary / secondary associated groups**
- **stand-alone isolated VLANs**.

A primary VLAN contains promiscuous ports that can communicate with all other ports in the private VLAN group, while a secondary (or community) VLAN contains community ports that can only communicate with other hosts within the secondary VLAN and with any of the promiscuous ports in the associated primary VLAN. Isolated VLANs, on the other hand, consist a single stand-alone VLAN that contains one promiscuous port and one or more isolated (or host) ports. In all cases, the promiscuous ports are designed to provide open access to an external network such as the Internet, while the community or isolated ports provide restricted access to local users.

Multiple primary VLANs can be configured on this Managed Switch, and multiple community VLANs can be associated with each primary VLAN. One or more isolated VLANs can also be configured.

Private VLANs and normal VLANs can exist simultaneously within the same switch.

■ Primary / secondary Associated Group

To configure primary/secondary associated groups, follow these steps:

1. Use the **Private VLAN Configuration** menu to designate one or more community VLANs, and the primary VLAN that will channel traffic outside of the VLAN groups.

2. Use the **Private VLAN Association** menu to map the secondary (i.e., community) VLAN(s) to the primary VLAN.

3. Use the **Private VLAN Port Configuration** menu to set the port type to promiscuous (i.e., having access to all ports in the primary VLAN), or host (i.e., having access restricted to community VLAN members, and channeling all other traffic through promiscuous ports). Then assign any promiscuous ports to a primary VLAN and any host ports a community VLAN.

■ Isolated VLAN

To configure an isolated VLAN, follow these steps:

1. Use the **Private VLAN Configuration** menu to designate an isolated VLAN that will channel all traffic through a single promiscuous port.

2. Use the **Private VLAN Port Configuration** menu to set the port type to **promiscuous** (i.e., the single channel to the external network), or isolated (i.e., having access only to the promiscuous port in its own VLAN). Then assign the **promiscuous port** and all host ports to an isolated VLAN.

4.8.3.1 Private VLAN Information

Displaying Current Private VLANs

The Private VLAN Information page displays information on the Private VLANs configured on the Managed Switch, including primary, community, and isolated VLANs, and their assigned interfaces.

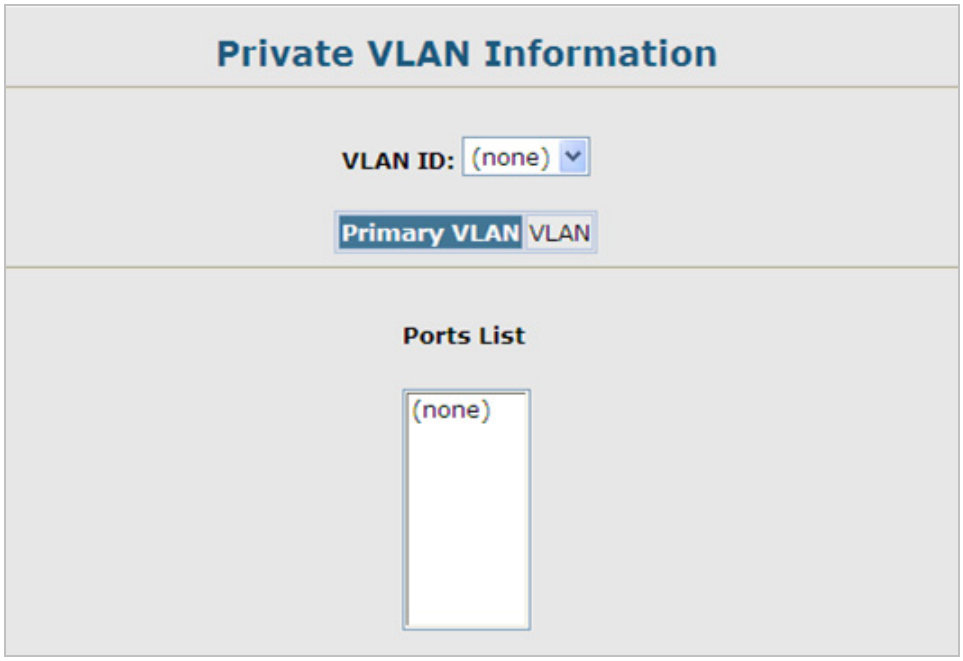


Figure 4-8-10.Private VLAN Information page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	ID of configured VLAN (2-4094), and VLAN type.
• **Primary VLAN**	The VLAN with which the selected VLAN ID is associated. A primary VLAN displays its own ID, a community VLAN displays the associated primary VLAN, and an isolated VLAN displays the stand-alone VLAN.
• **Ports List**	The list of ports (and assigned port type) in the selected private VLAN.

4.8.3.2 Private VLAN Configuration

Configuring Private VLANs

The Private VLAN Configuration page is used to create/remove primary, community, or isolated VLANs.

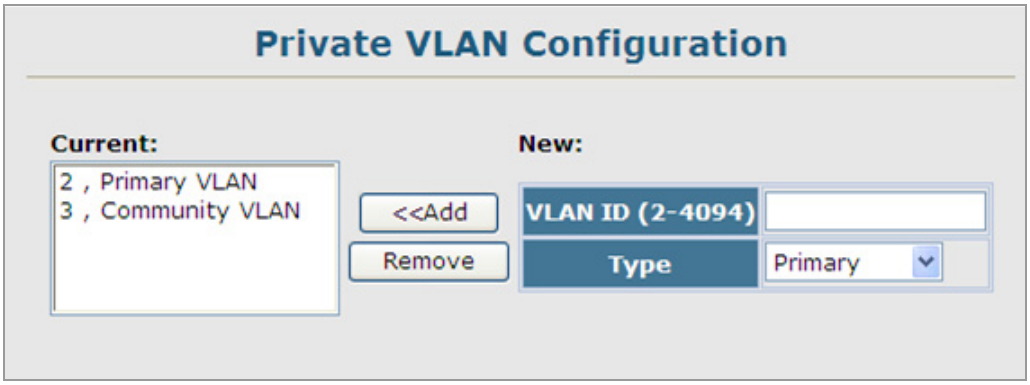


Figure 4-8-11.Private VLAN Configuration page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	ID of configured VLAN (2-4094).
• **Type**	There are three types of private VLANs: **- Primary VLANs** Conveys traffic between promiscuous ports, and to community ports within secondary (or community) **- Community VLANs** Conveys traffic between community ports, and to their promiscuous ports in the associated primary VLAN. **- Isolated VLANs** Conveys traffic only between the VLAN's isolated ports and promiscuous ports.
• **Current**	Displays a list of the currently configured VLANs.

4.8.3.3 Private VLAN Association

Each Community VLAN must be associated with a primary VLAN.

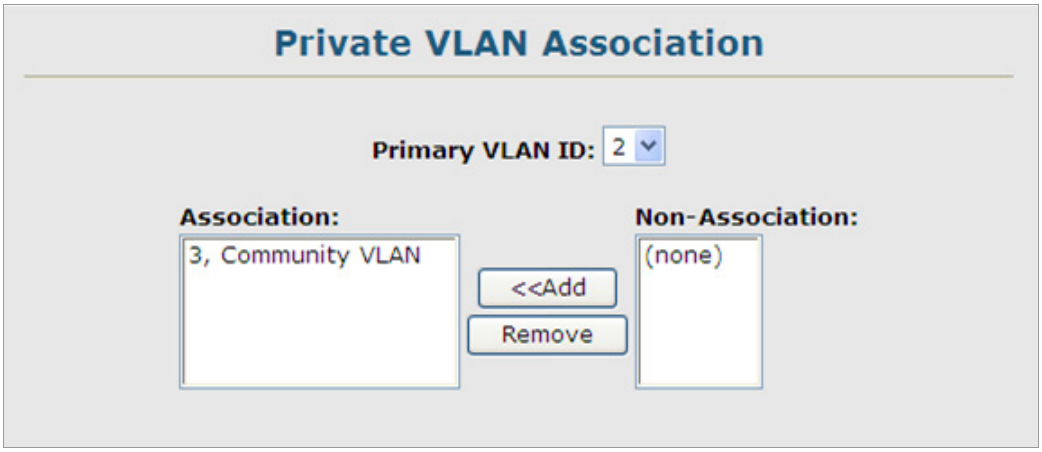


Figure 4-8-12. Private VLAN Association page screenshot

The page includes the following fields:

Object	Description
• **Primary VLAN ID**	ID of primary VLAN (2-4094).
• **Association**	**Community VLANs** associated with the selected primary VLAN.
• **Non-Association**	Community VLANs not associated with the selected VLAN.

4.8.3.4 Private VLAN Port Information

Use these menus to display the interfaces associated with Private VLANs.

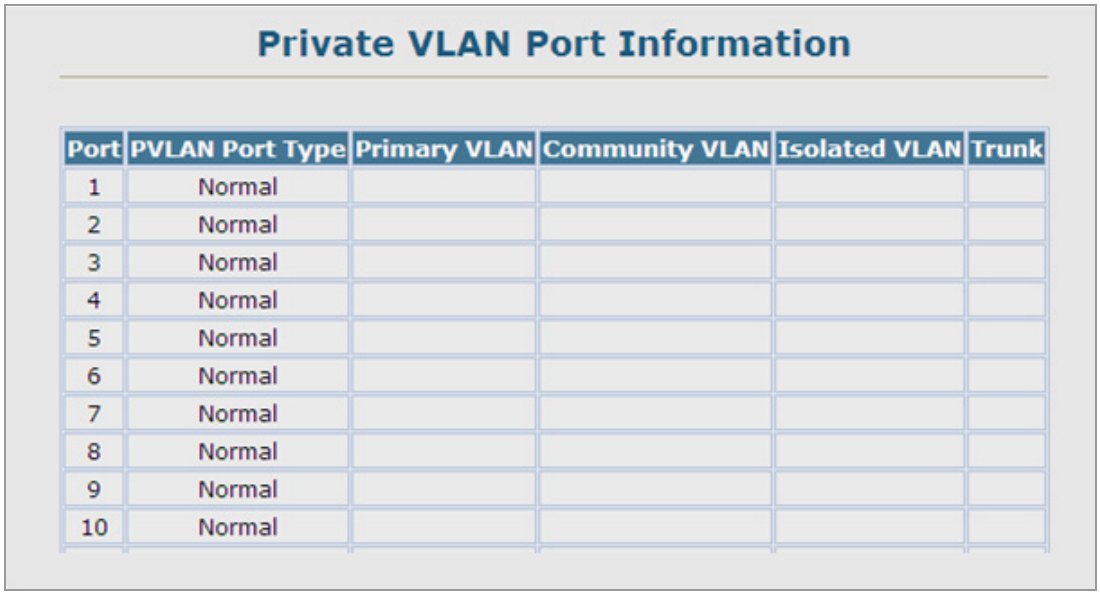


Figure 4-8-13. Private VLAN Port Information page screenshot

The page includes the following fields:

Object	Description
• **Port**	The switch interface.
• **PVLAN Port Type**	Displays private VLAN port types. **- Normal** The port is not configured in a private VLAN. **- Host** The port is a community port and can only communicate with other ports in its own community VLAN, and with the designated promiscuous port(s). Or the port is an isolated port that can only communicate with the lone promiscuous port within its own isolated VLAN. **- Promiscuous** A promiscuous port can communicate with all the interfaces within a private VLAN.
• **Primary VLAN**	Conveys traffic between promiscuous ports, and between promiscuous ports and community ports within the associated secondary VLANs.
• **Community VLAN**	Conveys traffic between community ports, and from community ports to their designated promiscuous ports.
• **Isolated VLAN**	A single stand-alone VLAN that contains one promiscuous port and one or more isolated (or host) ports. This VLAN conveys traffic between the isolated ports and a lone promiscuous port.

• **Trunk**	Shows if a port is a member or a trunk.

4.8.3.5 Private VLAN Port Configuration

Use these menus to set the private VLAN interface type, and associate the interfaces with a private VLAN.

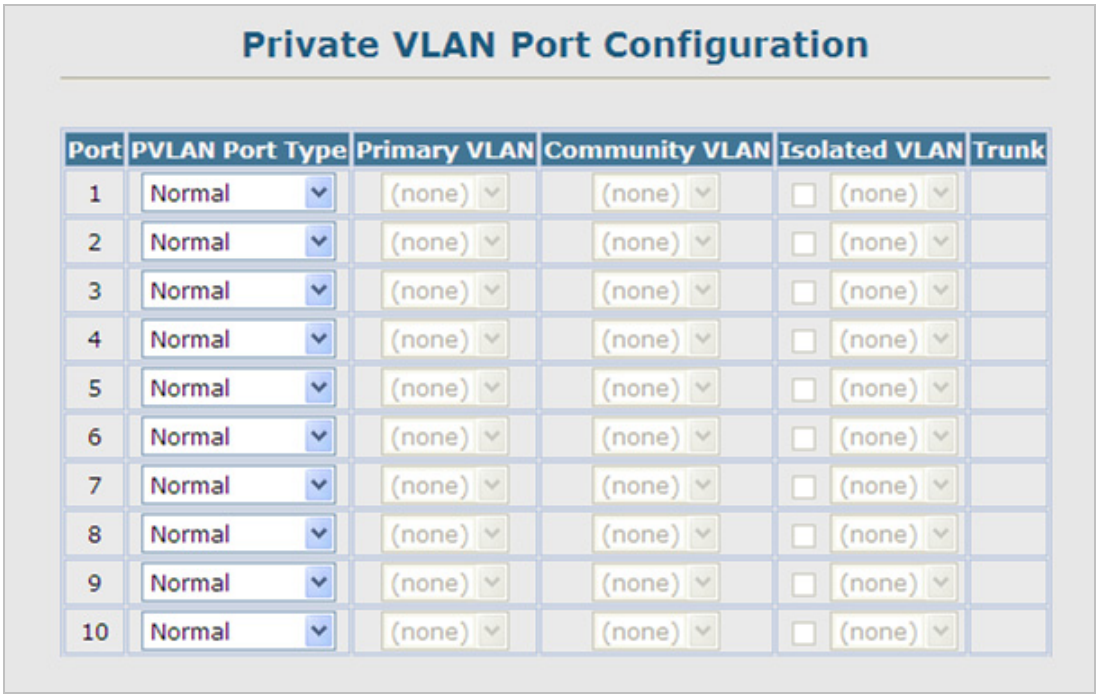


Figure 4-8-14. Private VLAN Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Port**	The switch interface.
• **PVLAN Port Type**	Displays private VLAN port types. **- Normal** The port is not configured in a private VLAN. **- Host** The port is a community port and can only communicate with other ports in its own community VLAN, and with the designated promiscuous port(s). Or the port is an isolated port that can only communicate with the lone promiscuous port within its own isolated VLAN. **- Promiscuous** A promiscuous port can communicate with all the interfaces within a private VLAN.
• **Primary VLAN**	Conveys traffic between promiscuous ports, and between promiscuous ports and community ports within the associated secondary VLANs.

	If PVLAN type is "**Promiscuous**," then specify the associated **Primary VLAN**.
• **Community VLAN**	Conveys traffic between community ports, and from community ports to their designated promiscuous ports. Set PVLAN Port Type to "**Host**," and then specify the associated **Community VLAN.**
• **Isolated VLAN**	A single stand-alone VLAN that contains one promiscuous port and one or more isolated (or host) ports. This VLAN conveys traffic between the isolated ports and a lone promiscuous port.
• **Trunk**	Shows if a port is a member or a trunk.

4.8.4 Protocol VLAN

The network devices required to support multiple protocols cannot be easily grouped into a common VLAN. This may require non-standard devices to pass traffic between different VLANs in order to encompass all the devices participating in a specific protocol. This kind of configuration deprives users of the basic benefits of VLANs, including security and easy accessibility.

To avoid these problems, you can configure this Managed Switch with protocol-based VLANs that divide the physical network into logical VLAN groups for each required protocol. When a frame is received at a port, its VLAN membership can then be determined based on the protocol type being used by the inbound packets.

Command Usage

To configure protocol-based VLANs, follow these steps:

1. First configure **VLAN groups for the protocols** you want to use. Although not mandatory, we suggest configuring a separate VLAN for each major protocol running on your network. Do not add port members at this time.
2. Create a **protocol group** for each of the protocols you want to assign to a VLAN using the Protocol VLAN Configuration page.
3. Then map the protocol for each interface to the appropriate VLAN using the Protocol VLAN Port Configuration page.

The following limitations apply to the use of Protocol VLANs:

- A maximum of 20 Protocol VLAN groups can be configured on the Managed Switch.
- One Protocol VLAN group can be configured for each of the predefined protocols of **IP**, **IPX**, and **Apple-talk** (Special Protocol field).
- Up to 17 Protocol VLAN groups can be created where both the frame type and protocol are user defined (Programmable Protocol) -please verify. Protocol VLAN groups created with the predefined protocols match all frame-types.
- Up to 5 Protocol VLAN groups can be concurrently mapped per port. One Protocol VLAN group for each of the predefined protocols can be mapped to a port, while a maximum of two groups based on user defined frame and protocol settings can be mapped per port. More than two user defined protocol groups cannot be mapped to a port, even if no predefined protocol groups are mapped to the port.

4.8.4.1 Protocol VLAN Configuration

Use the **Protocol VLAN Configuration** menu to create or remove protocol groups.

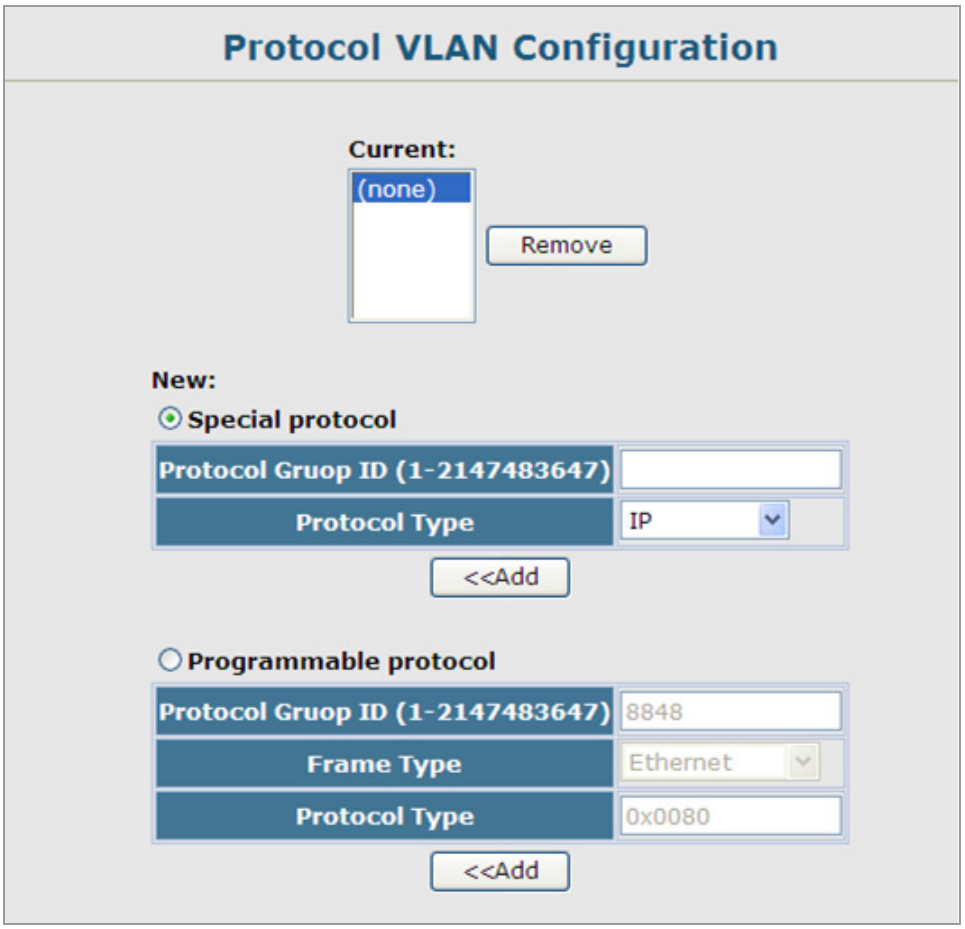


Figure 4-8-15. Protocol VLAN Configuration page screenshot

The page includes the following fields:

■ **Special Protocol**

Object	Description
• **Special Protocol**	Three fixed protocol types have been preconfigured.
• **Protocol Group ID**	Protocol Group ID assigned to the Special Protocol VLAN Group. (Range: 1-2147483647)
• **Protocol Type**	For these Protocol VLAN groups, the frame-type of network traffic is not considered (all frame types are accepted): - **IP** (0x0800) - **IPX** (0x8137) - **Apple-talk** (0x809B)

■ **Programmable Protocol**

Object	Description
• **Programmable Protocol**	The following options are available:
• **Frame Type**	The following frame types are available: - **Ethernet** - **LLC_other** - **RFC_1042** - **SNAP_8021H**
• **Protocol Type**	User defined.

Traffic which matches IP Protocol Ethernet Frames is mapped to the VLAN (VLAN 1) that has been configured with the switch's administrative IP. IP Protocol Ethernet traffic must not be mapped to another VLAN or you will lose administrative network connectivity to the switch. If lost in this manner, network access can be regained by removing the offending Protocol VLAN rule via the console. Alternately, the switch can be power-cycled, however all unsaved configuration changes will be lost.

4.8.4.2 Protocol VLAN Port Configuration

Use the **Protocol VLAN Port Configuration** menu to map a Protocol VLAN Group to a VLAN for the currently selected port or trunk.

Command Usage

- Before assigning a protocol group and associated VLAN to a port or trunk, first select the required interface from the scroll-down list and click Query.
- When a frame enters a port that has been assigned to a protocol VLAN, it is processed in the following manner:
  - If the frame is tagged, it will be processed according to the standard rules applied to tagged frames.
  - If the frame is untagged and the protocol type matches, the frame is forwarded to the appropriate VLAN.
  - If the frame is untagged but the protocol type does not match, the frame is forwarded to the default VLAN for this interface.

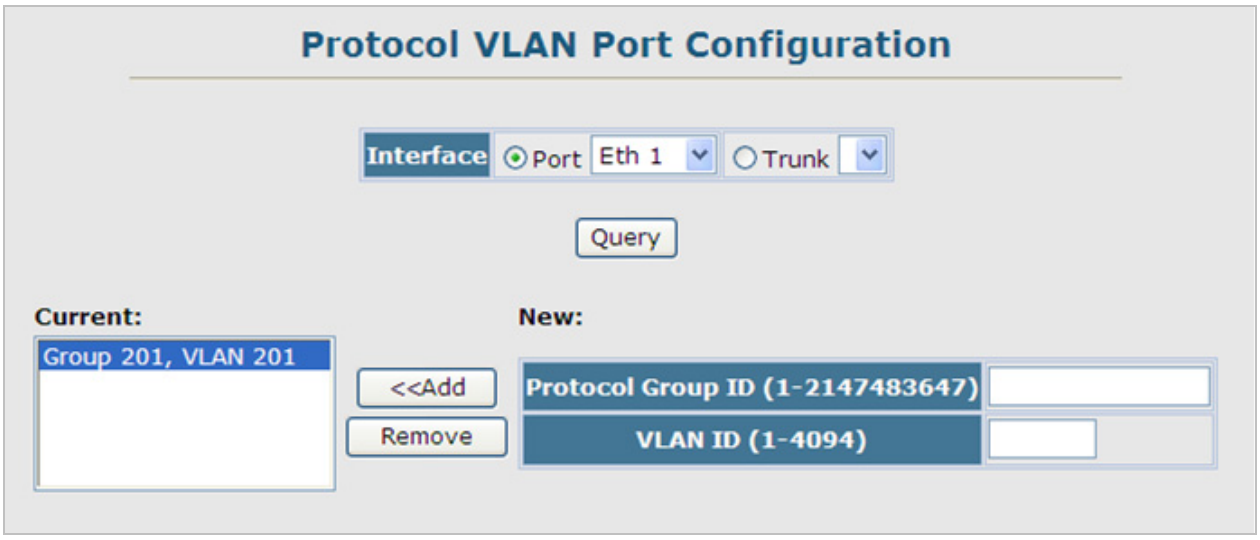


Figure 4-8-16. Protocol VLAN Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Interface**	Port or Trunk identifier.
• **Query**	Use this button to display the current protocol settings, and to select an interface for configuration.
• **Protocol Group ID**	Protocol Group ID assigned to the Protocol VLAN Group. (Range: 1-2147483647)
• **VLAN ID**	VLAN to which matching protocol traffic is forwarded. (Range: 1-4094)

4.9 Multicast

Multicasting is used to support real-time applications such as video conferencing or streaming audio. A multicast server does not have to establish a separate connection with each client. It merely broadcasts its service to the network, and any hosts that want to receive the multicast register with their local multicast switch/router. Although this approach reduces the network overhead required by a multicast server, the broadcast traffic must be carefully pruned at every multicast switch/router it passes through to ensure that traffic is only passed on the hosts that subscribed to this service.

This Managed Switch uses **IGMP (Internet Group Management Protocol)** to query for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting to join the service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service. This procedure is called **multicast filtering.**

The purpose of IP multicast filtering is to optimize a switched network's performance, so multicast packets will only be forwarded to those ports containing multicast group hosts or multicast routers/switches, instead of flooding traffic to all ports in the subnet (VLAN).

You can also configure a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation "**Multicast VLAN Registration**".

4.9.1 Layer 2 IGMP (Snooping and Query)

IGMP Snooping and Query – If multicast routing is not supported on other switches in your network, you can use IGMP Snooping and Query to monitor IGMP service requests passing between multicast clients and servers, and dynamically configure the switch ports which need to forward multicast traffic.

When using IGMPv3 snooping, service requests from IGMP Version 1, 2 or 3 hosts are all forwarded to the upstream router as IGMPv3 reports. The primary enhancement provided by IGMPv3 snooping is in keeping track of information about the specific multicast sources which downstream IGMPv3 hosts have requested or refused. The switch maintains information about both multicast groups and channels, where a group indicates a multicast flow for which the hosts have not requested a specific source (the only option for IGMPv1 and v2 hosts unless statically configured on the switch), and a channel indicates a flow for which the hosts have requested service from a specific source.

Only IGMPv3 hosts can request service from a specific multicast source. When downstream hosts request service from a specific source for a multicast service, these sources are all placed in the Include list, and traffic is forwarded to the hosts from each of these sources. IGMPv3 hosts may also request that service be forwarded from all sources except for those specified. In this case, traffic is filtered from sources in the Exclude list, and forwarded from all other available sources.

1. When the Managed Switch is configured to use IGMPv3 snooping, the snooping version may be downgraded to version 2 or version 1, depending on the version of the IGMP query packets detected on each VLAN.

2. IGMP snooping will not function unless a multicast router port is enabled on the switch. This can be accomplished in one of two ways. A static router port can be manually configured (see "**Specifying Static Interfaces for a Multicast Router**"). Using this method, the router port is never timed out, and will continue to function until explicitly removed. The other method relies on the switch to dynamically create multicast routing ports whenever multicast routing protocol packets or IGMP query packets are detected on a port.

3. A maximum of up to **255** multicast entries can be maintained for IGMP snooping, and 255 entries for Multicast Routing, when both of these features are enabled. If the table's capacity is exceeded, the IGMPv3 snooping will not support multicast source filtering, but will forward multicast traffic from all relevant sources to the requesting hosts.

Static IGMP Router Interface – If IGMP snooping cannot locate the IGMP querier, you can manually designate a known IGMP querier (i.e., a multicast router/switch) connected over the network to an interface on your switch. This interface will then join all the current multicast groups supported by the attached router/switch to ensure that multicast traffic is passed to all appropriate interfaces within the switch.

Static IGMP Host Interface – For multicast applications that you need to control more carefully, you can manually assign a multicast service to specific interfaces on the switch.

Configuring IGMP Snooping and Query Parameters

4.9.1.1 IGMP Configuration

You can configure the Managed Switch to forward multicast traffic intelligently. Based on the IGMP query and report messages, the Managed Switch forwards traffic only to the ports that request multicast traffic. This prevents the Managed Switch from broadcasting the traffic to all ports and possibly disrupting network performance.

Command Usage

- **IGMP Snooping –**

  This Managed Switch can passively snoop on IGMP Query and Report packets transferred between IP multicast routers/switches and IP multicast host groups to identify the IP multicast group members. It simply monitors the IGMP packets passing through it, picks out the group registration information, and configures the multicast filters accordingly.

Note

Unknown multicast traffic is flooded to all ports in the VLAN for several seconds when first received. If a multicast router port exists on the VLAN, the traffic will be filtered by subjecting it to IGMP snooping. If no router port exists on the VLAN or the multicast filtering table is already full, the switch will continue flooding the traffic into the VLAN.

- **IGMP Querier –**

A router, or multicast-enabled switch, can periodically ask their hosts if they want to receive multicast traffic. If there is more than one router/switch on the LAN performing IP multicasting, one of these devices is elected "**querier**" and assumes the role of querying the LAN for group members. It then propagates the service requests on to any upstream multicast switch/router to ensure that it will continue to receive the multicast service.

Note

Multicast routers use this information, along with a multicast routing protocol such as DVMRP or PIM, to support IP multicasting across the Internet.

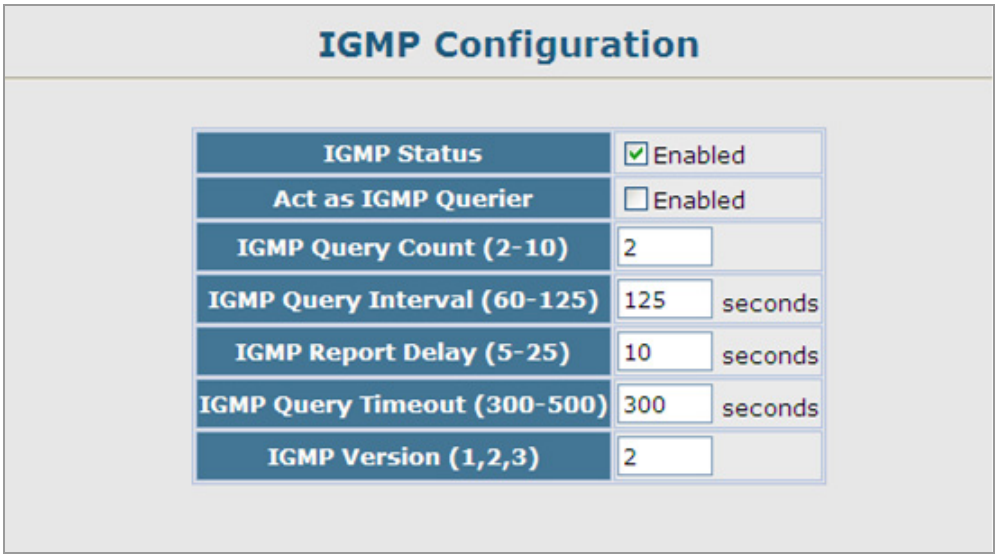


Figure 4-9-1 IGMP Configuration page screenshot

The page includes the following fields:

Object	Description
• **IGMP Status**	When enabled, the switch will monitor network traffic to determine which hosts want to receive multicast traffic. This is also referred to as IGMP Snooping. (Default: **Enabled**)
• **Act as IGMP Querier**	When enabled, the switch can serve as the Querier, which is responsible for asking hosts if they want to receive multicast traffic. This feature is not supported for IGMPv3 snooping.

	(Default: **Disabled**)
• **IGMP Query Count**	Sets the maximum number of queries issued for which there has been no response before the switch takes action to drop a client from the multicast group. Range: 2-10; Default: **2**
• **IGMP Query Interval**	Sets the frequency at which the switch sends IGMP host-query messages. Range: 60-125 seconds; Default: **125**
• **IGMP Report Delay**	Sets the time between receiving an IGMP Report for an IP multicast address on a port before the switch sends an IGMP Query out of that port and removes the entry from its list. Range: 5-25 seconds; Default: **10**
• **IGMP Query Timeout**	The time the switch waits after the previous querier stops before it considers the router port (i.e., the interface which had been receiving query packets) to have expired. Range: 300-500 seconds; Default: **300**
• **IGMP Version**	Sets the protocol version for compatibility with other devices on the network. Range: 1-3; Default: **2**

1. All systems on the subnet must support the same version.
2. Some attributes are only enabled for IGMPv2 and/or v3, including Act as IGMP Querier, IGMP Report Delay and IGMP Query Timeout.

4.9.1.2 IGMP Immediate Leave

The Managed Switch can be configured to immediately delete a member port of a multicast service if a leave packet is received at that port and the immediate-leave function is enabled for the parent VLAN. This allows the Managed witch to remove a port from the multicast forwarding table without first having to send an IGMP group-specific query to that interface.

Command Usage

- If immediate leave is not used, a multicast router (or querier) will send a group-specific query message when an IGMPv2/v3 group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified timeout period. Note that the timeout period is determined by the IGMP Query Report Delay (see "Configuring IGMP Snooping and Query Parameters").
- If immediate leave is enabled, the Managed witch assumes that only one host is connected to the interface. Therefore,

immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, either a service host or a neighbor running IGMP snooping.

- Immediate leave is only effective if IGMP snooping is enabled, and IGMPv2 or IGMPv3 snooping is used.
- Immediate leave does not apply to a port if the Managed witch has learned that a multicast router is attached to it.
- Immediate leave can improve bandwidth usage for a network which frequently experiences many IGMP host add and leave requests.

Figure 4-9-2 IGMP Immediate Leave page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	VLAN Identifier. (Range: 1-4094)
• **Immediate Leave**	Sets the status for immediate leave on the specified VLAN. (Default: **Disabled**)

4.9.1.3 Multicast Router Port Information

Multicast routers that are attached to ports on the Managed Switch use information obtained from IGMP, along with a multicast routing protocol such as DVMRP or PIM, to support IP multicasting across the Internet. These routers may be dynamically discovered by the switch or statically assigned to an interface on the switch.

You can use the Multicast Router Port Information page to display the ports on this Managed Switch attached to a neighboring multicast router/switch for each VLAN ID.

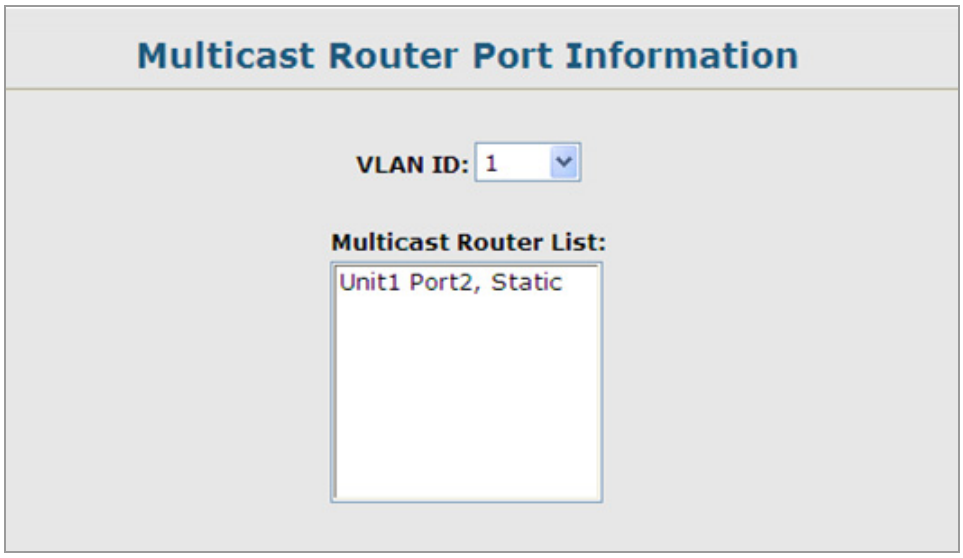


Figure 4-9-3 Multicast Router Port Information page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	ID of configured VLAN Range: 1-4094.
• **Multicast Router List**	Multicast routers dynamically discovered by this switch or those that are statically assigned to an interface on this Managed Switch.

4.9.1.4 Static Multicast Router Port Configuration

Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/ switch connected over the network to an interface (port or trunk) on your Managed Switch, you can manually configure the interface (and a specified VLAN) to join all the current multicast groups supported by the attached router. This can ensure that multicast traffic is passed to all the appropriate interfaces within the Managed Switch.

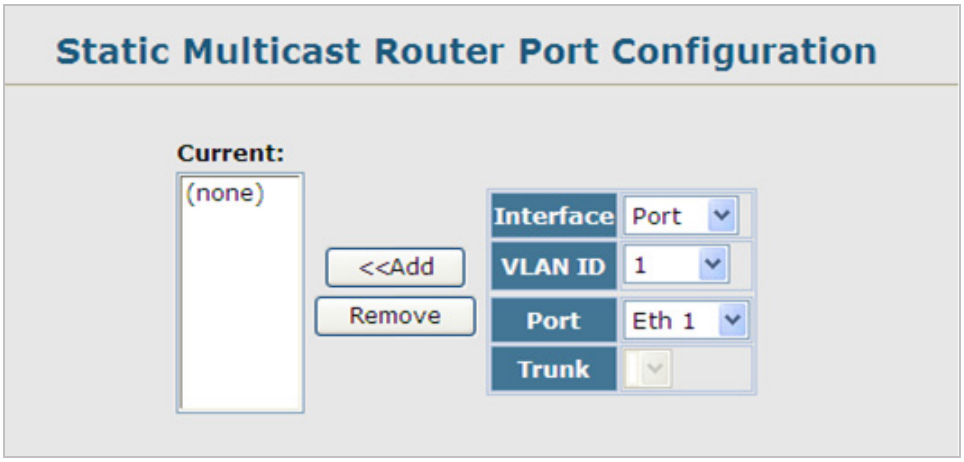


Figure 4-9-4 Static Multicast Router Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Interface**	Activates the Port or Trunk scroll down list.
• **VLAN ID**	Selects the VLAN to propagate all multicast traffic coming from the attached multicast router.
• **Port or Trunk**	Specifies the interface attached to a multicast router.

4.9.1.5 IP Multicast Registration Table

You can use the IP Multicast Registration Table to display the port members associated with a specified VLAN and multicast service.

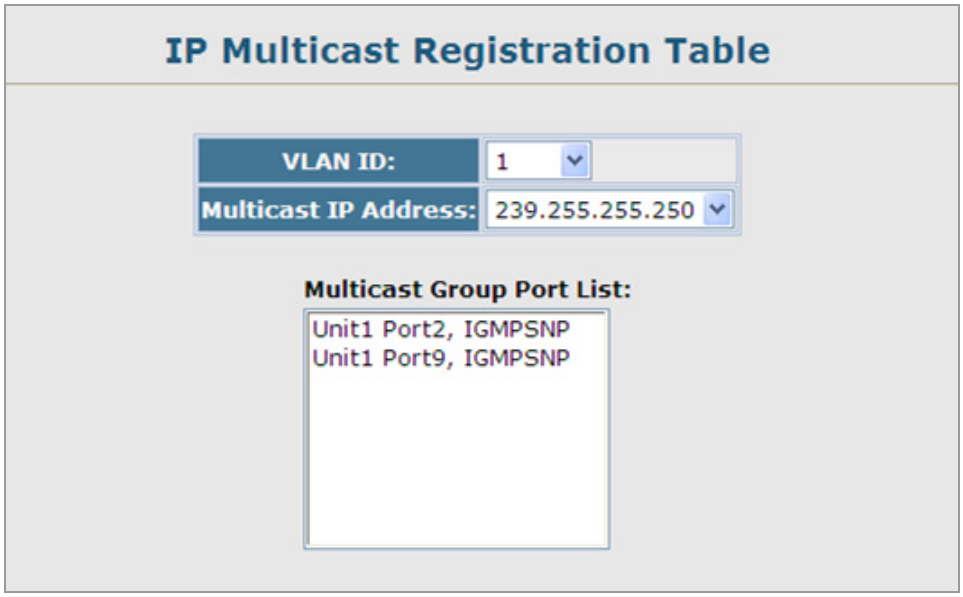


Figure 4-9-5 IP Multicast Registration Table page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	Selects the VLAN for which to display port members. (Range: 1-4094)
• **Multicast IP Address**	The IP address for a specific multicast service.
• **Multicast Group Port List**	Shows the interfaces that have already been assigned to the selected VLAN to propagate a specific multicast service.

To show all the multicast services / groups on the Managed Switch and the member ports of each multicast group, type the below command at command line mode:

```
Console# show mac-address-table multicast
VLAN    M'cast IP addr.     Member ports    Type
-------  ------------------  ------------------  ------
1        224.1.1.12          Eth1/12         USER
1        224.1.2.3           Eth1/12         IGMP
```

4.9.1.6 IGMP Member Port Table

Multicast filtering can be dynamically configured using IGMP Snooping and IGMP Query messages as described in **IGMP Configuration**. For certain applications that require tighter control, you may need to statically configure a multicast service on the Managed Switch. First add all the ports attached to participating hosts to a common VLAN, and then assign the multicast service to that VLAN group.

- Static multicast addresses are never aged out.
- When a multicast address is assigned to an interface in a specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

Command Sequence –

1. Specify the **interface** attached to a multicast service (via an IGMP-enabled switch or multicast router)
2. Indicate the **VLAN** that will propagate the multicast service
3. Specify the **multicast IP address**
4. Click **Add**.

5. After you have completed adding ports to the member list, click **Apply**.

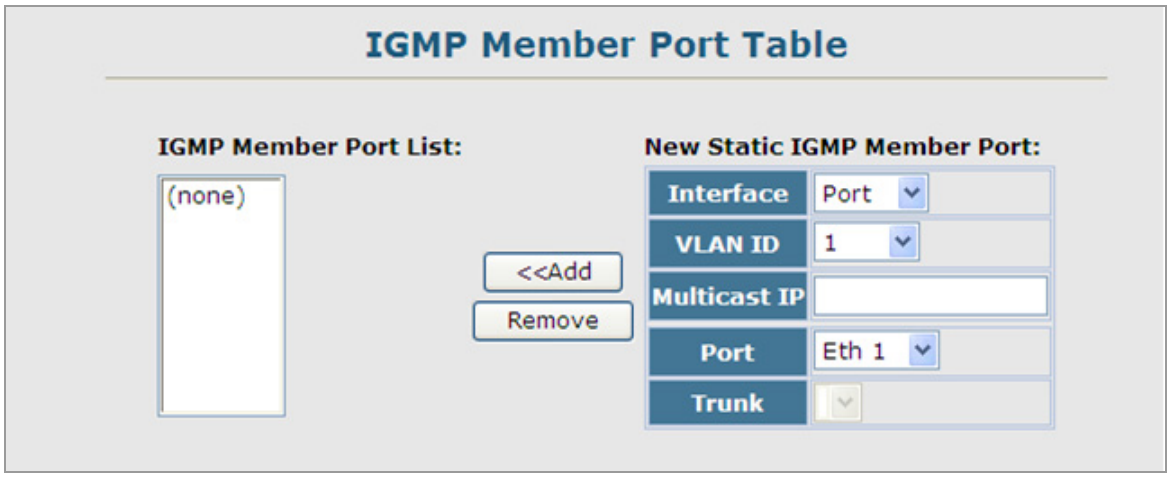


Figure 4-9-6 IGMP Member Port Table page screenshot

The page includes the following fields:

Object	Description
• **Interface**	Activates the Port or Trunk scroll down list.
• **VLAN ID**	Selects the VLAN to propagate all multicast traffic coming from the attached multicast router/switch. (Range: 1-4094)
• **Multicast IP**	The IP address for a specific multicast service
• **Port or Trunk**	Specifies the interface attached to a multicast router/switch.

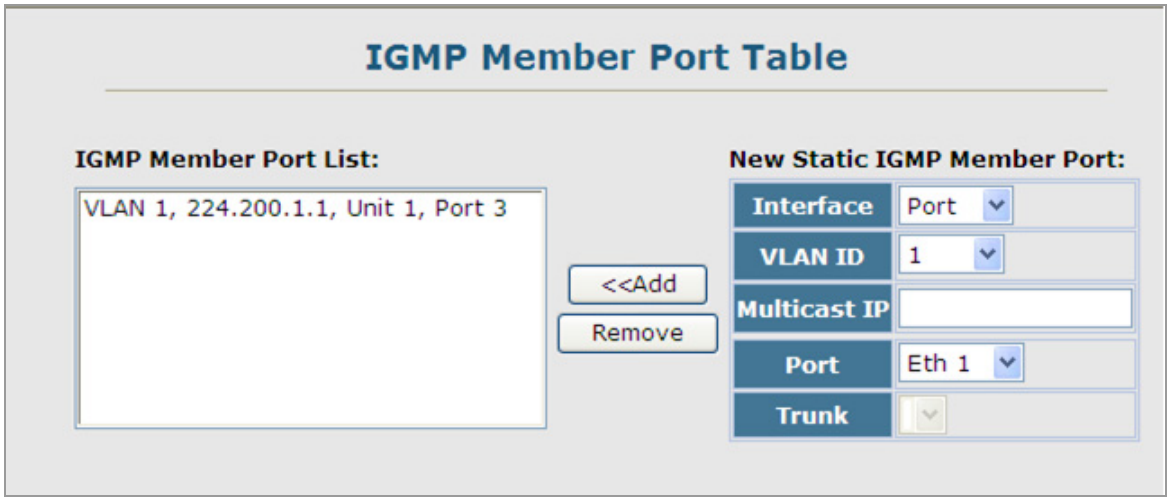


Figure 4-9-7 IGMP Member Port Table page screenshot

4.9.2 IGMP Filter and Throttling

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The IGMP filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and IGMP throttling limits the number of simultaneous multicast groups a port can join.

IGMP filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An IGMP filter profile can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, IGMP join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the IGMP join report is forwarded as normal. If a requested multicast group is denied, the IGMP join report is dropped.

IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace". If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

IGMP filtering and throttling only applies to dynamically learned multicast groups. It does not apply to statically configured groups.

4.9.2.1 IGMP Filter Profile Configuration

To implement IGMP filtering and throttling on the Managed Switch, you must first enable the feature globally and create IGMP profile numbers.

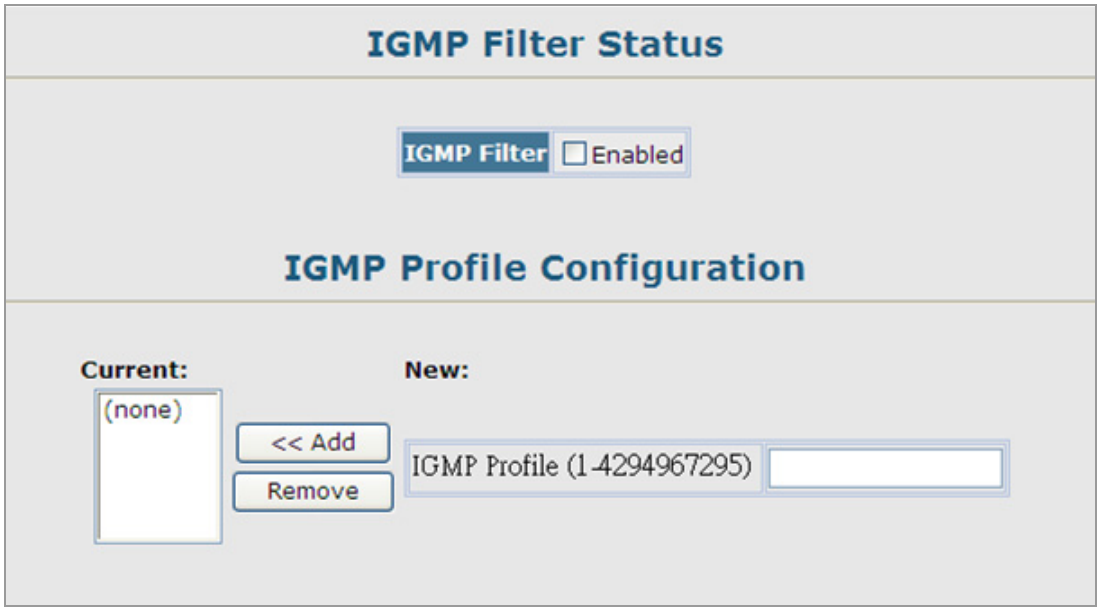


Figure 4-9-8 IGMP Filter Profile Configuration page screenshot

The page includes the following fields:

Object	Description
• **IGMP Filter**	Enables IGMP filtering and throttling globally for the switch. (Default: **Disabled**)
• **IGMP Profile**	Creates IGMP profile numbers. (Range: 1-4294967295)

4.9.2.2 IGMP Filter Profile Configuration

When you have created an IGMP profile number, you can then configure the multicast groups to filter and set the access mode.

Command Usage

- Each profile has only one access mode; either **permit** or **deny**.
- When the access mode is set to **permit**, IGMP join reports are processed when a multicast group falls within the controlled range.
- When the access mode is set to **deny**, IGMP join reports are only processed when the multicast group is not in the controlled range.

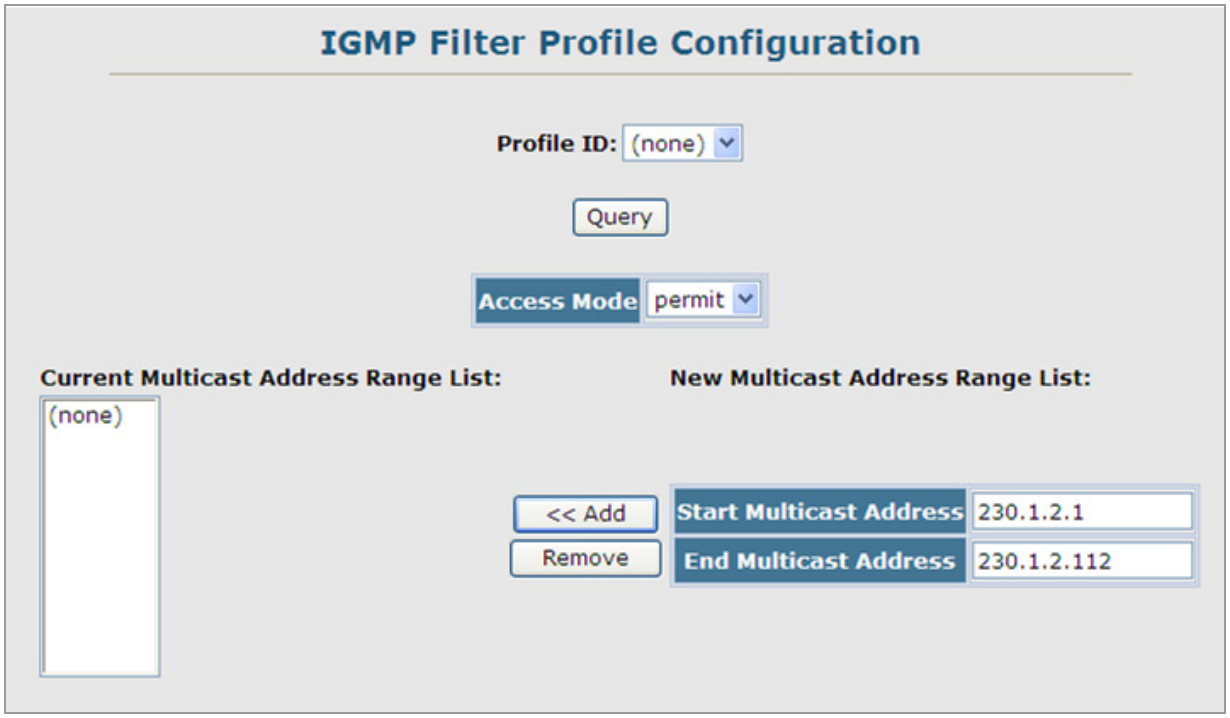


Figure 4-9-9 IGMP Filter Profile Configuration page screenshot

The page includes the following fields:

Object	Description	
• **Profile ID**	Selects an existing profile number to configure. After selecting an ID number, click the Query button to display the current configuration.	
• **Access Mode**	Sets the access mode of the profile; either **permit** or **deny**.	
	- Permit	IGMP join reports are processed when a multicast group falls within the controlled range.
	- Deny	When the access mode is set to, IGMP join reports are only processed when the multicast group is not in the controlled range.
	(Default: Deny)	
• **New Multicast Address Range List**	Specifies multicast groups to include in the profile. Specify a multicast group range by entering a start and end IP address. Specify a single multicast group by entering the same IP address for the start and end of the range. Click the Add button to add a range to the current list.	
• **Current Multicast Address Range List**	Lists multicast groups currently included in the profile. Select an entry and click the Remove button to delete it from the list.	

4.9.2.3 IGMP Filter / Throttling Port Configuration

Once you have configured IGMP profiles, you can assign them to interfaces on the Managed Switch. Also you can set the IGMP throttling number to limit the number of multicast groups an interface can join at the same time.

Command Usage

- Only one profile can be assigned to an interface.
- An IGMP profile or throttling setting can also be applied to a trunk interface. When ports are configured as trunk members, the trunk uses the settings applied to the first port member in the trunk.
- IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace". If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

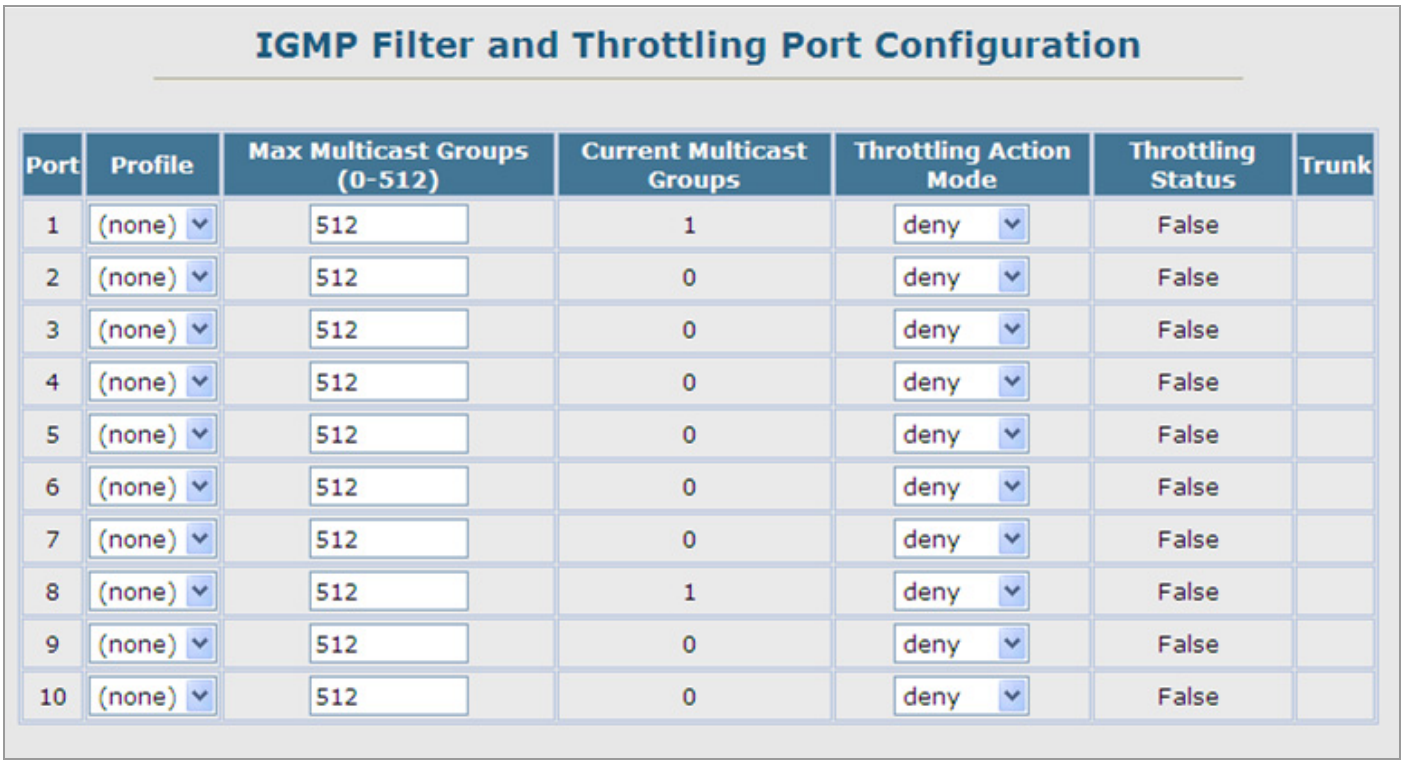

IGMP Filter and Throttling Port Configuration
Port
Profile
Max Multicast Groups (0-512)
Current Multicast Groups
Throttling Action Mode
Throttling Status
Trunk
1 (none) 512 1 deny False
2 (none) 512 0 deny False
3 (none) 512 0 deny False
4 (none) 512 0 deny False
5 (none) 512 0 deny False
6 (none) 512 0 deny False
7 (none) 512 0 deny False
8 (none) 512 1 deny False
9 (none) 512 0 deny False
10 (none) 512 0 deny False

Figure 4-9-10 IGMP Filter and Throttling Port Configuration page screenshot

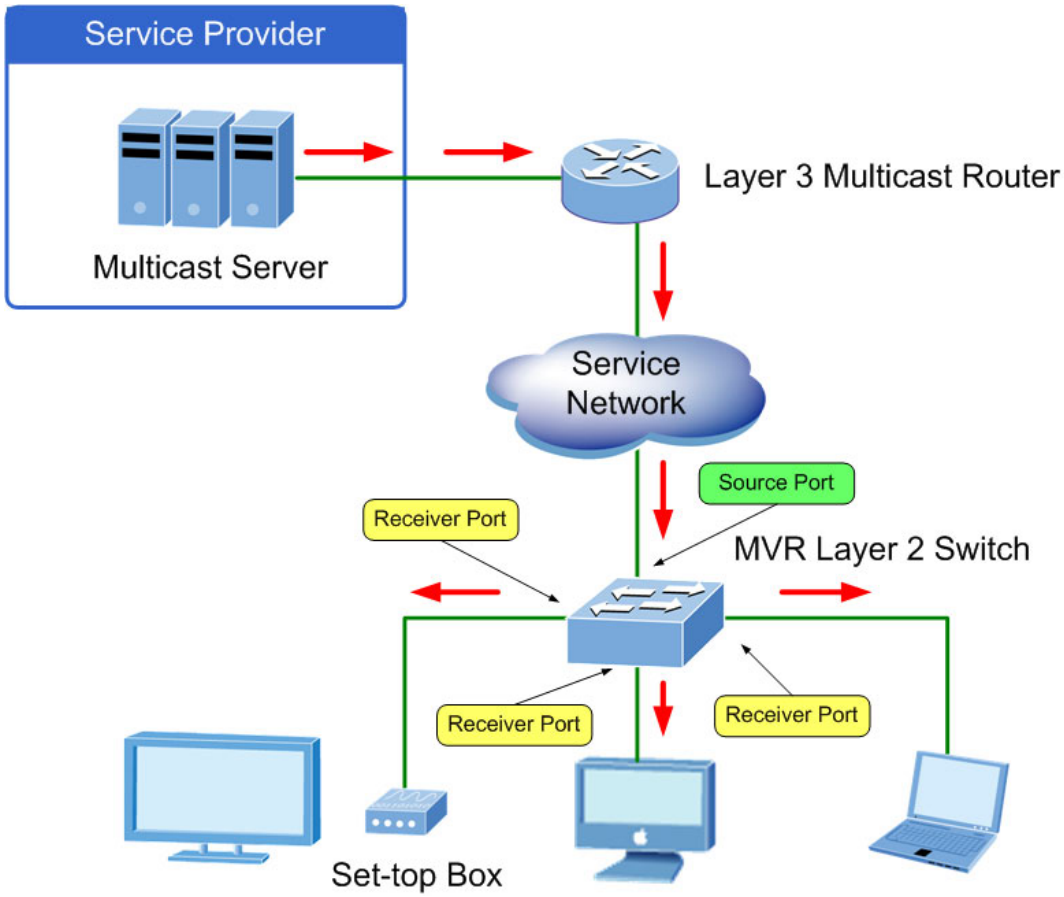
The page includes the following fields:

Object	Description
• **Profile**	Selects an existing profile number to assign to an interface.
• **Max Multicast Groups**	Sets the maximum number of multicast groups an interface can join at the same time. Range: 0-255; Default: **255**
• **Current Multicast Groups**	Displays the current number of multicast groups the interface has joined.
• **Throttling Action Mode**	Sets the action to take when the maximum number of multicast groups for the interface has been exceeded. (Default: Deny) -**deny** - The new multicast group join report is dropped. -**replace** - The new multicast group replaces an existing group.
• **Throttling Status**	Indicates if the throttling action has been implemented on the interface. Options: **- True** **- False**
• **Trunk**	Indicates if a port is a trunk member.

4.9.3 Multicast VLAN Registration (MVR)

Multicast VLAN Registration (MVR) is a protocol that controls access to a single network-wide VLAN most commonly used for transmitting multicast traffic (such as television channels or video-on-demand) across a service provider's network. Any multicast traffic entering an MVR VLAN is sent to all attached subscribers. This protocol can significantly reduce the processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. This makes it possible to support common multicast services over a wide part of the network without having to use any multicast routing protocol.

MVR maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong. Even though common multicast streams are passed onto different VLAN groups from the MVR VLAN, users in different IEEE 802.1Q or private VLANs cannot exchange any information (except through upper-level routing services).



General Configuration Guidelines for MVR

1. Enable MVR globally on the Managed Switch, select the **MVR VLAN**, and add the multicast groups that will stream traffic to attached hosts (see "Configuring Global MVR Settings").
2. Set the interfaces that will join the MVR as source ports or receiver ports (see "Configuring MVR Interface Status").
3. Enable IGMP Snooping to an allow a subscriber to dynamically join or leave an MVR group (see "Configuring IGMP Snooping and Query Parameters").

Note

Only IGMP version 2 or 3 hosts can issue multicast join or leave messages.

4. For multicast streams that will run for a long term and be associated with a stable set of hosts, you can statically bind the multicast group to the participating interfaces (see "Assigning Static Multicast Groups to Interfaces").

4.9.3.1 MVR Configuration

Configuring Global MVR Settings

The global settings for Multicast VLAN Registration (MVR) include enabling or disabling MVR for the Managed Switch, selecting the VLAN that will serve as the sole channel for common multicast streams supported by the service provider, and assigning the multicast group address for each of these services to the MVR VLAN.

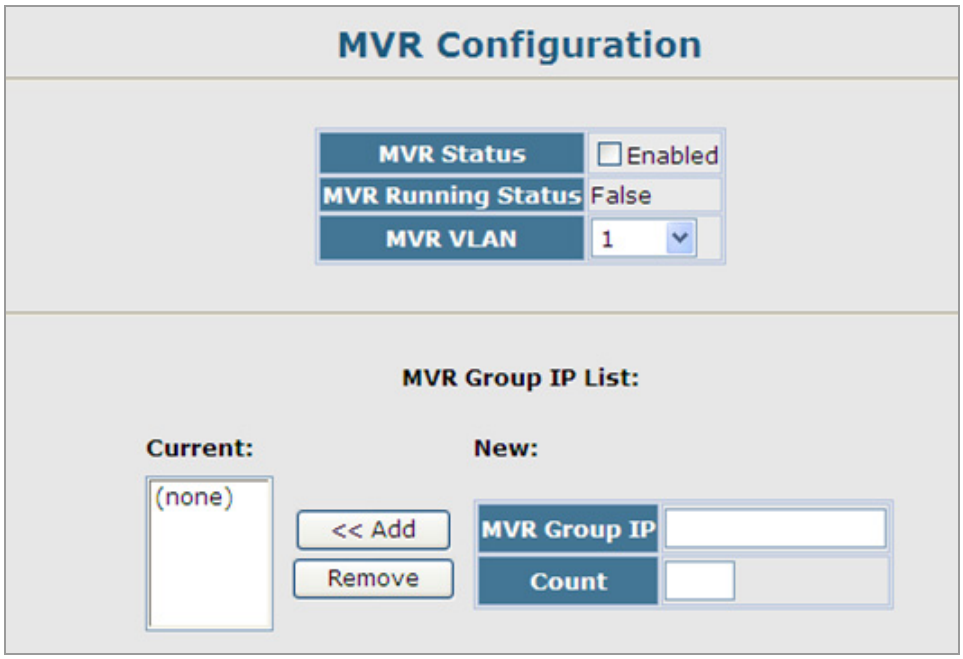


Figure 4-9-11 MVR Configuration page screenshot

The page includes the following fields:

Object	Description
• **MVR Status**	When MVR is enabled on the switch, any multicast data associated with an MVR group is sent from all designated source ports, and to all receiver ports that have registered to receive data from that multicast group. (Default: **Disabled**)
• **MVR Running Status**	Indicates whether or not all necessary conditions in the MVR environment are

	satisfied. (Running status is true as long as MVR Status is enabled, and the specified MVR VLAN exists.)
• **MVR VLAN**	Identifier of the VLAN that serves as the channel for streaming multicast services using MVR. **MVR source ports should be configured as members of the MVR VLAN** (see "Adding Static Members to VLANs (VLAN Index)"), but MVR receiver ports should not be manually configured as members of this VLAN. Range: 1-4094; Default: **1**
• **MVR Group IP**	IP address for an MVR multicast group. The IP address range of 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x. Range: 224.0.1.0 - 239.255.255.255; Default: no groups are assigned to the MVR VLAN
• **Count**	The number of contiguous MVR group addresses. Range: 1-255; Default: **0**

4.9.3.2 MVR Port Configuration

Each interface that participates in the MVR VLAN must be configured as an MVR source port or receiver port. If only one subscriber attached to an interface is receiving multicast services, you can enable the immediate leave function.

Command Usage

- A port which is not configured as an MVR receiver or source port can use IGMP snooping to join or leave multicast groups using the standard rules for multicast filtering.
- Receiver ports can belong to different VLANs, but should not be configured as a member of the MVR VLAN. IGMP snooping can be used to allow a receiver port to dynamically join or leave multicast groups within an MVR VLAN. Multicast groups can also be statically assigned to a receiver port (see "Assigning Static Multicast Groups to Interfaces"). However, if a receiver port is statically configured as a member of an MVR VLAN, its MVR status will be inactive. Also, note that VLAN membership for MVR receiver ports cannot be set to trunk mode (see "Configuring VLAN Behavior for Interfaces").
- One or more interfaces may be configured as MVR source ports. A source port is able to both receive and send data for multicast groups which it has joined through IGMP snooping or which have been statically assigned (see "Assigning Static Multicast Groups to Interfaces").
- Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.
  - Using immediate leave can speed up leave latency, but should only be enabled on a port attached to one multicast subscriber to avoid disrupting services to other group members attached to the same interface.

- Immediate leave does not apply to multicast groups which have been statically assigned to a port.

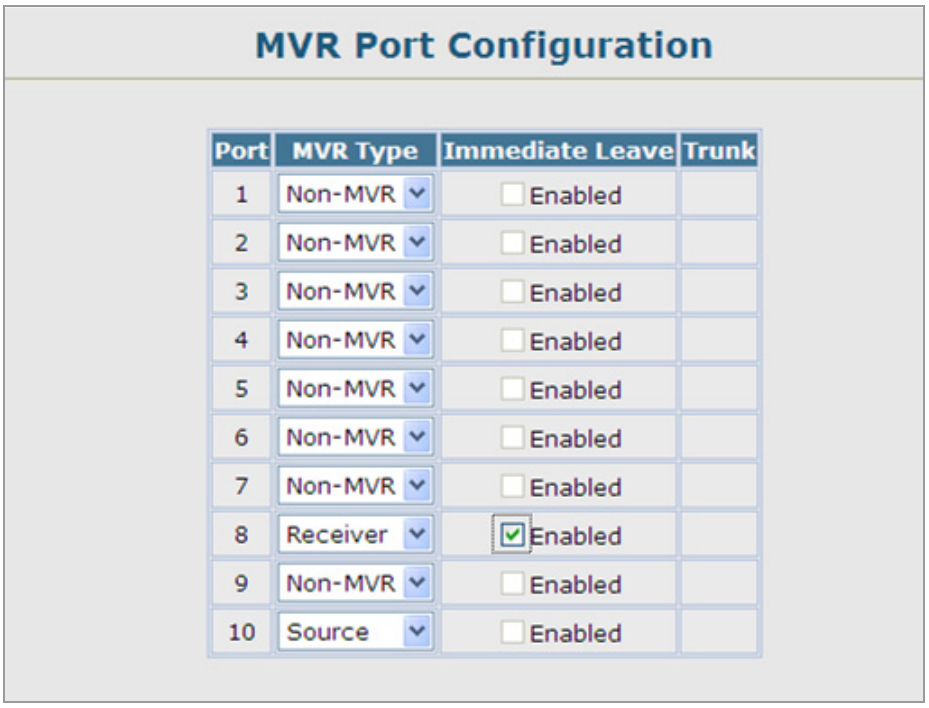


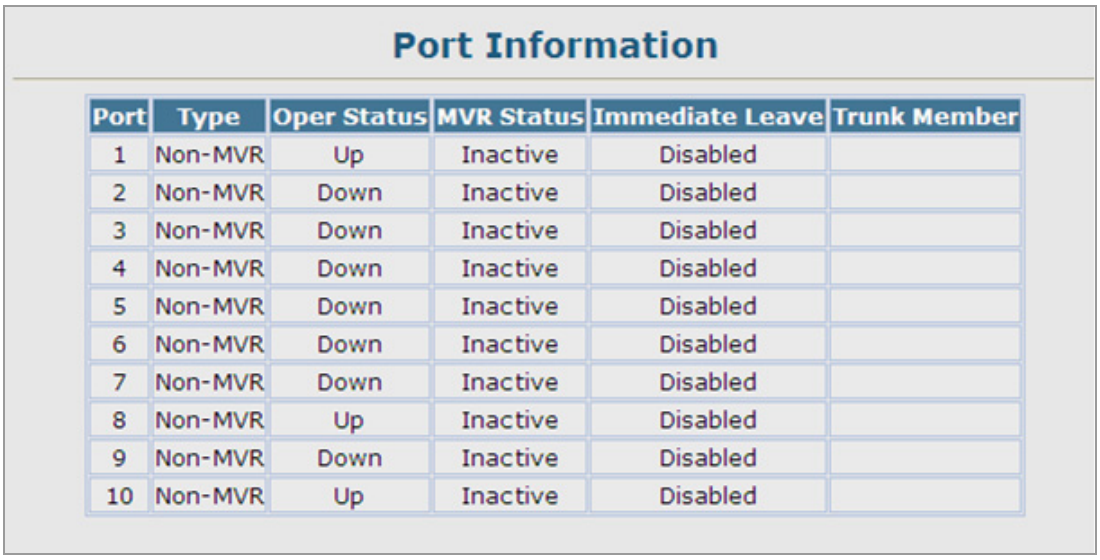
Figure 4-9-12 MVR Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **MVR Type**	The following interface types are supported: **-Source** An uplink port that can send and receive multicast data for the groups assigned to the MVR VLAN. Note that the source port must be manually configured as a member of the MVR VLAN (see "Adding Static Members to VLANs (VLAN Index)"). **-Receiver** A subscriber port that can receive multicast data sent through the MVR VLAN. Any port configured as an receiver port will be dynamically added to the MVR VLAN when it forwards an IGMP report or join message from an attached host requesting any of the designated multicast services supported by the MVR VLAN. **-Non-MVR** An interface that does not participate in the MVR VLAN. Default type : **Non-MVR**
• **Immediate Leave**	Configures the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group. (This option only applies to an interface configured as an **MVR receiver**.)
• **Trunk**	Shows if port is a trunk member.

4.9.3.3 MVR Port Information

You can display information about the interfaces attached to the MVR VLAN.



Port Information

Port	Type	Oper Status	MVR Status	Immediate Leave	Trunk Member
1	Non-MVR	Up	Inactive	Disabled	
2	Non-MVR	Down	Inactive	Disabled	
3	Non-MVR	Down	Inactive	Disabled	
4	Non-MVR	Down	Inactive	Disabled	
5	Non-MVR	Down	Inactive	Disabled	
6	Non-MVR	Down	Inactive	Disabled	
7	Non-MVR	Down	Inactive	Disabled	
8	Non-MVR	Up	Inactive	Disabled	
9	Non-MVR	Down	Inactive	Disabled	
10	Non-MVR	Up	Inactive	Disabled	

Figure 4-9-13 Port Information page screenshot

The page includes the following fields:

Object	Description
• **Type**	Shows the MVR port type.
• **Oper Status**	Shows the link status.
• **MVR Status**	Shows the MVR status. MVR status for source ports is "ACTIVE" if MVR is globally enabled on the Managed Switch. MVR status for receiver ports is "ACTIVE" only if there are subscribers receiving multicast traffic from one of the MVR groups, or a multicast group has been statically assigned to an interface.
• **Immediate Leave**	Shows if immediate leave is enabled or disabled.
• **Trunk Member**	Shows if port is a trunk member.

4.9.3.4 MVR Group Member Configuration

For multicast streams that will run for a long term and be associated with a stable set of hosts, you can statically bind the multicast group to the participating interfaces.

Command Usage

- Any multicast groups that use the MVR VLAN must be statically assigned to it under the MVR Configuration menu (see "Configuring Global MVR Settings".
- The IP address range from **224.0.0.0 to 239.255.255.255** is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.

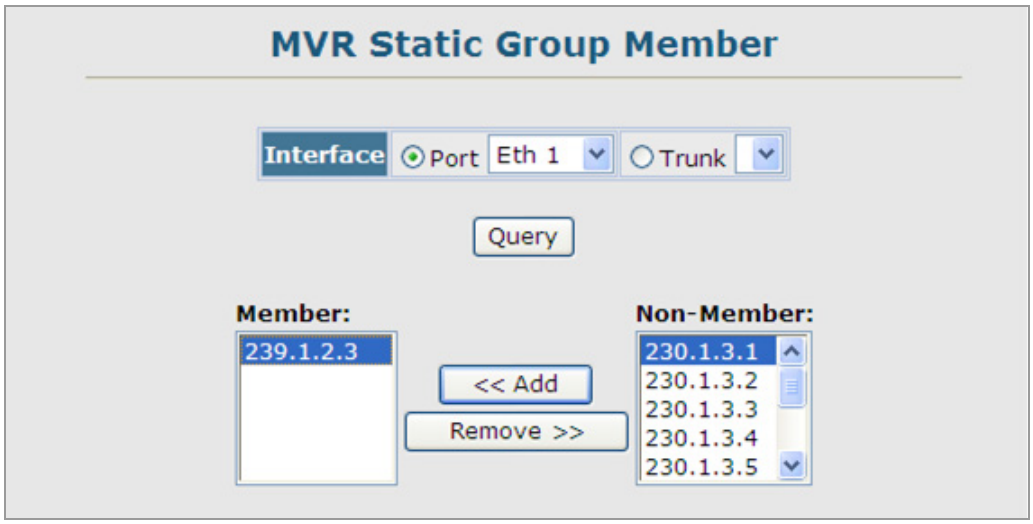


Figure 4-9-14 MVR Static Group Member page screenshot

1. Click **MVR**, **Group Member Configuration**.
2. Select a **port** or **trunk** from the "Interface" field, and click **Query** to display the assigned multicast groups.
3. Select a **multicast address** from the displayed lists, and click the **Add** or **Remove** button to modify the Member list.

The page includes the following fields:

Object	Description
• **Interface**	Indicates a port or trunk.
• **Member**	Shows the IP addresses for MVR multicast groups which have been statically assigned to the selected interface.
• **Non-Member**	Shows the IP addresses for all MVR multicast groups which have not been statically assigned to the selected interface.

4.9.3.5 MVR Group IP Information

You can display the multicast groups assigned to the MVR VLAN either through IGMP snooping or static configuration.

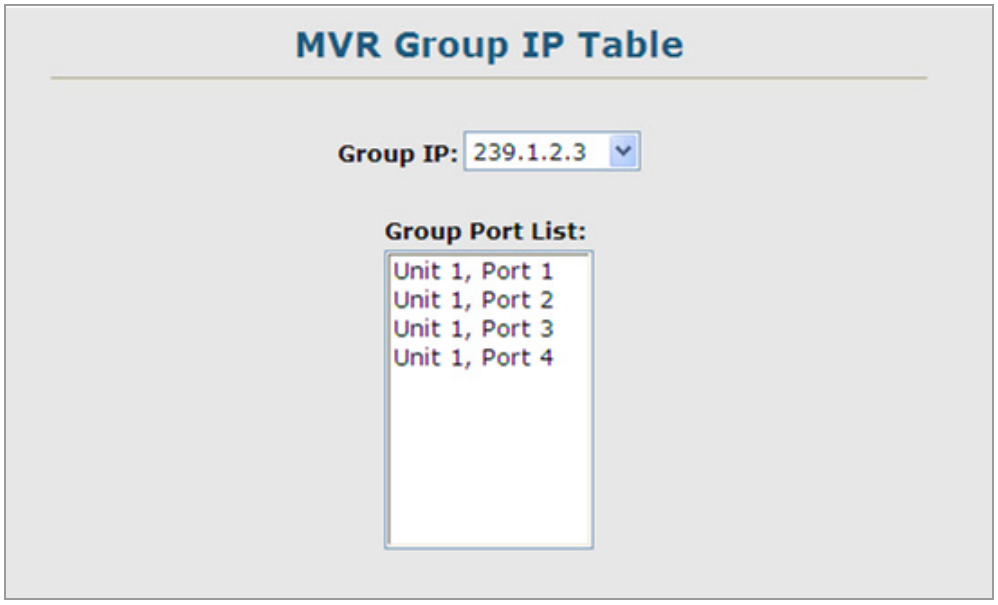


Figure 4-9-15 MVR Group IP Table page screenshot

The page includes the following fields:

Object	Description
Group IP	Multicast groups assigned to the MVR VLAN.
Group Port List	Shows the interfaces with subscribers for multicast services provided through the MVR VLAN.

4.10 Quality of Service

This Managed Switch prioritizes each packet based on the required level of service, using four priority queues with strict priority, Weighted Round Robin, or hybrid queuing. It uses IEEE 802.1p and 802.1Q tags to prioritize incoming traffic based on input from the end-station application. These functions can be used to provide independent priorities for delay-sensitive data and best-effort data.

This Managed Switch also supports several common methods of prioritizing layer 3/4 traffic to meet application requirements. Traffic can be prioritized based on the IPv4 header Type-of-Service field using DSCP, IP Precedence, IP TOS values, or TCP/UDP port numbers. When these services are enabled, the priorities are mapped to a Class of Service output queue.

Quality of Service – Differentiated Services (DiffServ) provides policy-based management mechanisms used for prioritizing network resources to meet the requirements of specific traffic types on a per-hop basis. Each packet is classified upon entry into the network based on access lists, IP Precedence or DSCP values, or VLAN lists. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding.

This section has the following items:

Priority	
■ **Default Port Priority**	Sets the default priority for each port
■ **Default Trunk Priority**	Sets the default priority for each trunk
■ **Traffic Classes**	Maps IEEE 802.1p priority tags to output queues
■ **Queue Mode**	Sets queue mode to strict, Weighted Round-Robin, or hybrid
■ **Queue Scheduling**	Configures Weighted Round Robin queueing
■ **IP DSCP Priority Status**	Globally enables DSCP priority
■ **IP DSCP Priority**	Sets IP Differentiated Services Code Point priority, mapping a DSCP tag to a class-of-service queue
■ **IP Port Priority Status**	Globally enables IP port priority
■ **IP Port Priority**	Sets IP port priority, mapping TCP/UDP ports to class-of-service queues
■ **IP Precedence Priority Status**	Globally enables IP precedence priority
■ **IP Precedence Priority**	Sets IP precedence priority, mapping IP precedence values to class-of-service queues
■ **IP TOS Priority Status**	Globally enables IP ToS priority
■ **IP TOS Priority**	Sets IP ToS priority, mapping IP ToS values to class-of-service queues
■ **ACL CoS Priority**	Sets ACL priority, mapping IP and MAC ACLs to class-of-service queues

DiffServ	Configures QoS classification criteria and service policies
■ **Class Map**	Sets Class Maps
■ **Policy Map**	Sets Policy Maps

■ **Service Policy**	Defines service policy settings for ports
VoIP	Voice over IP
■ **Configuration**	Sets a Voice VLAN ID and enables VoIP traffic detection
■ **Port Configuration**	Configures port VoIP traffic mode, security, and priority
■ **OUI Configuration**	Configures VoIP device OUI identification

4.10.1 Priority

Class of Service (CoS) allows you to specify which data packets have greater precedence when traffic is buffered in the Managed Switch due to congestion. This Managed Switch supports CoS with four priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. You can set the default priority for each interface, and configure the mapping of frame priority tags to the Managed Switch's priority queues.

You can specify the default port priority for each interface on the switch. All untagged packets entering the switch are tagged with the specified default port priority, and then sorted into the appropriate priority queue at the output port.

Command Usage

This Managed Switch provides four priority queues for each port. It uses **Weighted Round Robin** to prevent head-of-queue blockage.

The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.

If the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission

■ **Default Port Priority**	Sets the default priority for each port
■ **IP Port Priority**	Sets IP port priority, mapping TCP/UDP ports to class-of-service queues
■ **IP DSCP Priority**	Sets IP Differentiated Services Code Point priority, mapping a DSCP tag to a class-of-service queue
■ **IP Precedence Priority**	Sets IP precedence priority, mapping IP precedence values to class-of-service queues
■ **IP TOS Priority**	Sets IP ToS priority, mapping IP ToS values to class-of-service queues
■ **ACL CoS Priority**	Sets ACL priority, mapping IP and MAC ACLs to class-of-service queues

4.10.1.1 Port Priority Configuration

You can specify the default port priority for each interface on the Managed Switch. All untagged packets entering the Managed Switch are tagged with the specified default port priority, and then sorted into the appropriate egress queue at the output port.

- This Managed Switch provides **four egress queues** for each port. It uses **Weighted Round Robin** to prevent head-of-queue blockage.
- The default priority applies for an untagged frame received on a port set to accept all frame types (i.e., receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.
- If the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.

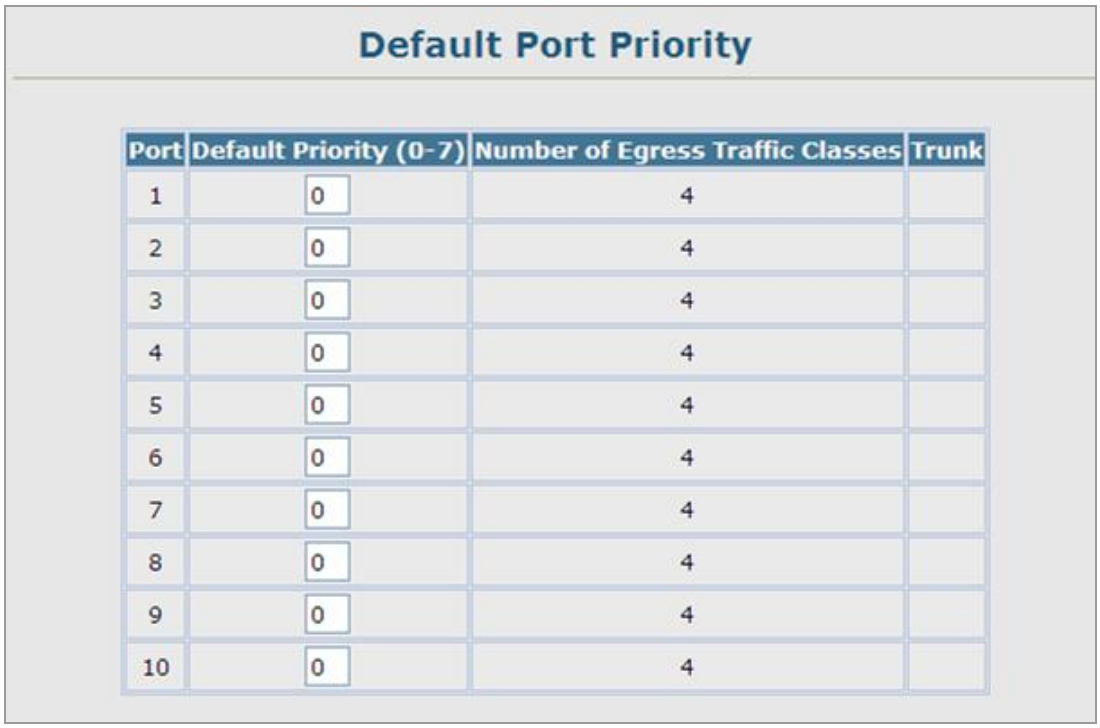


Figure 4-10-1 Default Port Priority page screenshot

The page includes the following fields:

Object	Description
• **Port**	Numeric identifier for the Managed Switch port.
• **Default Priority**	The priority that is assigned to untagged frames received on the specified interface. Range: 0-7; Default: **0**
• **Number of Egress Traffic Classes**	The number of queue buffers provided for each port.
• **Trunk**	The trunk identifier. (Port Priority Configuration only)

4.10.1.2 Traffic Classes

IEEE 802.1p CoS Priority

This Managed Switch processes **Class of Service (CoS)** priority tagged traffic by using four egress queues for each port, with service schedules based on **Weighted Round Robin (WRR)**. Up to eight separate traffic priority levels are defined in IEEE 802.1p. The default priority levels are assigned according to recommendations in the IEEE 802.1p standard as shown in the following table:

802.1p Priority	0	1	2	3	4	5	6	7
Queue	1	0	0	1	2	2	3	3

Table 4-10-1 Mapping CoS Values to Egress Queues

Command Sequence –

1. Mark an interface and click **Select** to display the current mapping of CoS values to output queues.
2. Assign priorities to the traffic classes (i.e., output queues) for the selected interface, then click **Apply**.

Figure 4-10-2 Traffic Classes page screenshot

The page includes the following fields:

Object	Description
• **Interface**	Selects the port or trunk interface settings to display and modify.
• **Priority**	CoS value.

	(Range: 0-7, where **7** is the highest priority)
• **Traffic Class**	Output queue buffer. (Range: 0-3, where **3** is the highest CoS priority queue)

The default priority levels are assigned according to recommendations in the IEEE 802.1p standard. However, you can map the priority levels to the Managed Switch's output queues in any way that benefits application traffic for your own network.

Priority Level	Traffic Type
1	Background
2	(Spare)
0 (default)	Best Effort
3	Excellent Effort
4	Controlled Load
5	Video, less than 100 milliseconds latency and jitter
6	Voice, less than 10 milliseconds latency and jitter
7	Network Control

Table 4-10-2 CoS Priority Levels

4.10.1.3 Queue Mode

Selecting the Queue Mode

You can set the Managed Switch to service the queues based on a **strict** rule that requires all traffic in a higher priority queue to be processed before lower priority queues are serviced, or use **Weighted Round-Robin (WRR)** queuing that specifies a relative weight of each queue, or a combination of strict service for the high priority queues and weighted queueing for the remaining queues.

Command Usage

- **Strict priority** requires all traffic in a higher priority queue to be processed before lower priority queues are serviced.
- **WRR** uses a relative weighting for each queue which determines the amount of packets the switch transmits every time it services each queue before moving on to the next queue. Thus, a queue weighted 8 will be allowed to transmit up to 8 packets, after which the next lower priority queue will be serviced according to it's weighting. This prevents the head-of-line blocking that can occur with strict priority queuing.
- **Hybrid** mode uses strict priority queuing for the highest priority queue (queue 3) processing queues 2 through 0 according to their WRR weights.

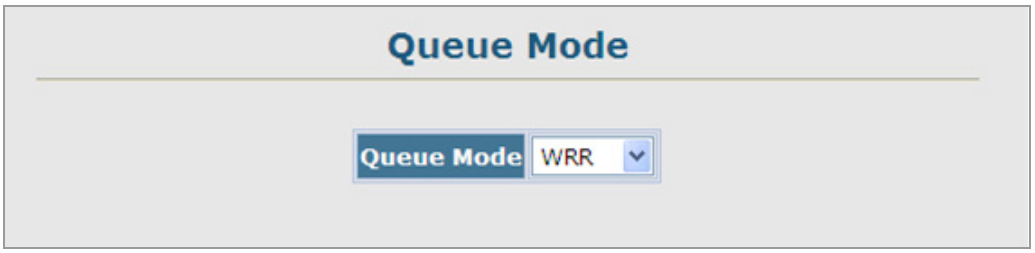


Figure 4-10-3 Queue Mode page screenshot

The page includes the following fields:

Object	Description
Strict	Services the egress queues in sequential order, transmitting all traffic in the higher priority queues before servicing lower priority queues.
WRR	Weighted Round-Robin shares bandwidth at the egress ports by using scheduling weights with default values of 1, 2, 4, 8 for queues 0 through 3, respectively. (This is the default selection.)
Hybrid	Services the highest priority queue (3) according to strict priority queuing, after which the 3 lower priority queues (0, 1, 2) are processed according to their WRR weightings.

4.10.1.4 Queue Scheduling

The Managed Switch uses the **Weighted Round Robin (WRR)** algorithm to determine the frequency at which it services each egress queue. The traffic classes are mapped to one of the **four egress queues** provided for each port. You can assign a weight to each of these queues (and thereby to the corresponding traffic priorities). This weight sets the frequency at which each queue will be polled for service, and subsequently affects the response time for software applications assigned a specific priority value.

Command Usage

- WRR controls bandwidth sharing at the egress port by defining scheduling weights for allocated service priorities. When using WRR, assign a weight of 1-15 to each of the hardware queues.
- A queue's weight must be less than or equal to the weight of the next higher priority queue (that is, **Q0 ≤Q1 ≤Q2 ≤ Q3**).

1. Click **Priority**, **Queue Scheduling**.
2. Select and highlight a **Traffic Class** (i.e., output queue), enter a **Weight Value**, then click Apply.

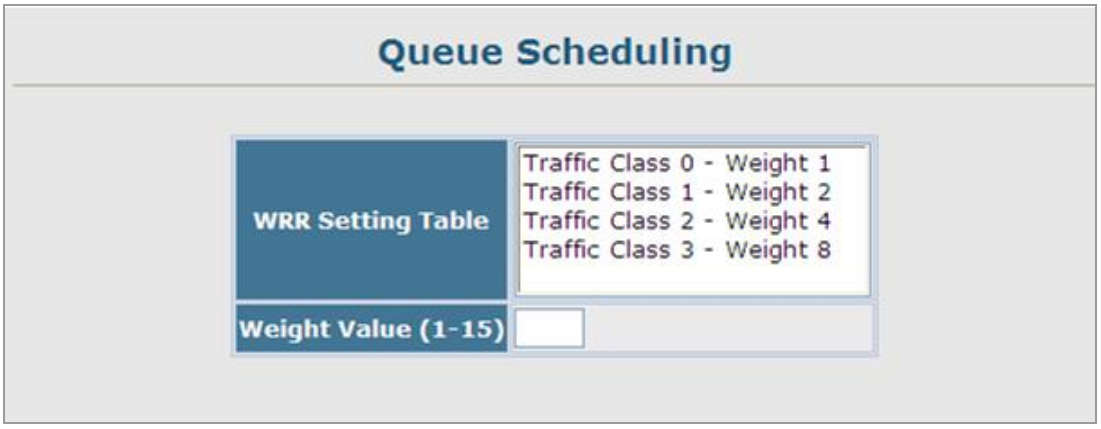

Queue Scheduling
WRR Setting Table
Traffic Class 0 - Weight 1
Traffic Class 1 - Weight 2
Traffic Class 2 - Weight 4
Traffic Class 3 - Weight 8
Weight Value (1-15)

Figure 4-10-4 Queue Scheduling page screenshot

The page includes the following fields:

Object	Description
WRR Setting Table	Displays a list of weights for each traffic class (i.e., queue).
Weight Value	Set a new weight for the selected traffic class. (Range: 1-15)

4.10.2 Layer 3/4 Priority Settings

4.10.2.1 Mapping Layer 3/4 Priorities to CoS Values

This Managed Switch supports several common methods of prioritizing layer 3/4 traffic to meet application requirements. Traffic priorities can be specified in the IP header of a frame, using the priority bits in the **Type of Service (TOS)** octet or the number of the TCP port. If the priority bits are used, the TOS octet may contain three bits for **IP Precedence**, four bits for IP TOS (see page 3-227), or six bits for **Differentiated Services Code Point (DSCP)** service. When these services are enabled, the priorities are mapped to a Class of Service output queue.

Because different priority information may be contained in the traffic, the Managed Switch maps priority values to the output queues in the following manner – The precedence for priority mapping is IP Port Priority, IP Precedence/DSCP/ToS Priority, and then Default Port Priority.

4.10.2.2 IP DSCP Priority Status

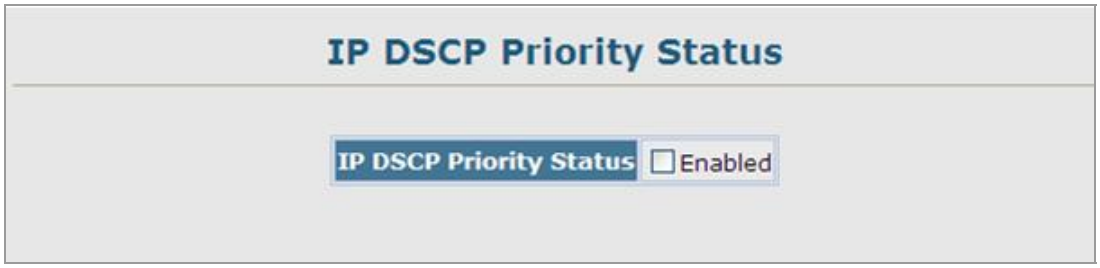


Figure 4-10-5 IP DSCP Priority Status page screenshot

The page includes the following fields:

Object	Description
IP DSCP Priority Status	**Enables** or **disables** IP DSCP priority.

Note

IP DSCP priority settings apply to all interfaces.

4.10.2.3 IP DSCP Priority

The DSCP is **six bits** wide, allowing coding for up to 64 different forwarding behaviors. The DSCP retains backward compatibility with the three precedence bits so that non-DSCP compliant, TOS-enabled devices, will not conflict with the DSCP mapping. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding.

The DSCP default values are defined in the following table. Note that all the DSCP values that are not specified are mapped to CoS queue 0.

IP DSCP Value	CoS Queue
0, 8	**0**
10, 12, 14, 16, 18, 20, 22, 24	**1**
26, 28, 30, 32, 34, 36, 38, 40, 42	**2**
46, 48, 56	**3**

Table 4-10-3 IP DSCP to CoS Queue Mapping

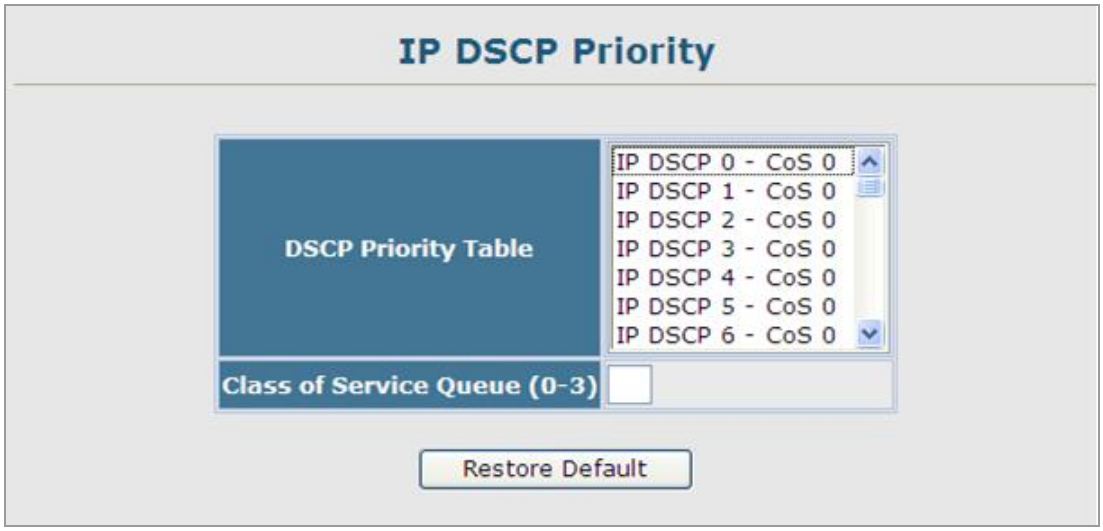

IP DSCP Priority
DSCP Priority Table
IP DSCP 0 - CoS 0
IP DSCP 1 - CoS 0
IP DSCP 2 - CoS 0
IP DSCP 3 - CoS 0
IP DSCP 4 - CoS 0
IP DSCP 5 - CoS 0
IP DSCP 6 - CoS 0
Class of Service Queue (0-3)
Restore Default

Figure 4-10-6 IP DSCP Priority page screenshot

The page includes the following fields:

Object	Description
DSCP Priority Table	Shows the DSCP Priority to CoS queue map.
Class of Queue Service Value	Maps the selected DSCP Priority value to a CoS output queue. Note that queue "**0**" represents low priority and "**3**" represent high priority.

4.10.2.4 Mapping IP Precedence Priority

The Type of Service (TOS) octet in the IPv4 header includes three precedence bits defining eight different priority levels ranging from **highest priority (7)** for network control packets to **lowest priority (0)** for routine traffic. Bits 6 and 7 are used for network control, and the other bits for various application types. Precedence values are defined in the following table.

IP Precedence Value	Traffic Type	Default CoS Output Queue
0	Routine	**0**
1	Priority	**0**
2	Immediate	**1**
3	Flash	**1**
4	Flash Override	**2**
5	Critical	**2**
6	Internetwork Control	**3**
7	Network Control	**3**

Table 4-10-4 Mapping IP Precedence Values to CoS Priority Queues

1. Click QoS, Priority, **IP Precedence Priority Status**.
2. Set the IP Precedence Priority Status to **Enabled**.
3. Click QoS, Priority, **IP Precedence Priority**.
4. Select an entry from the IP Precedence Priority Table, enter a queue number in the Class of Queue Service Value field, and then click Apply.

4.10.2.5 IP Precedence Priority Status

Figure 4-10-7 IP Precedence Priority Status page screenshot

The page includes the following fields:

Object	Description
IP Precedence Priority Status	**Enables** or **disables** the IP Precedence priority.

Note

IP Precedence priority settings apply to all interfaces.

4.10.2.6 IP Precedence Priority

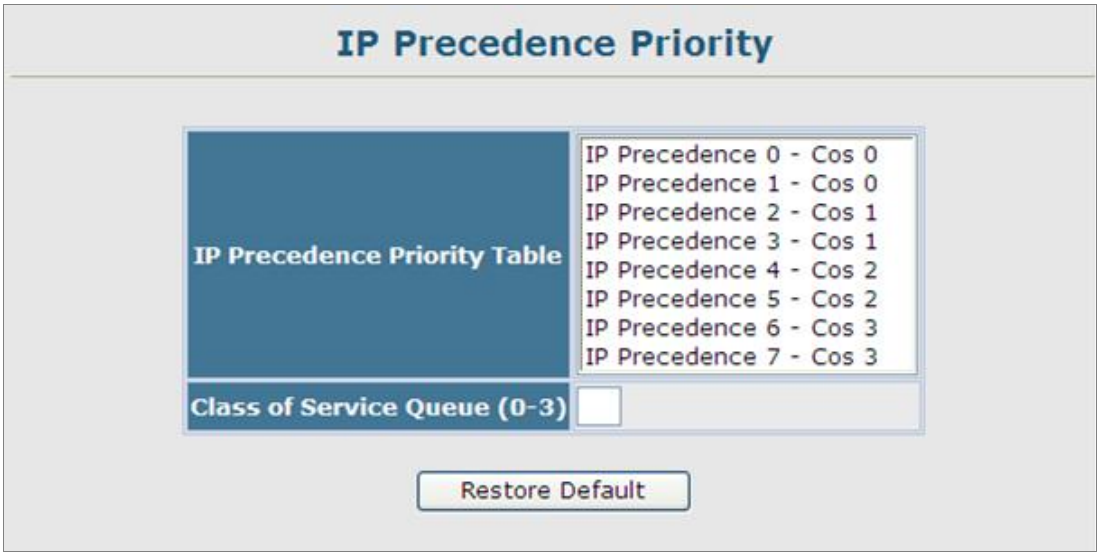

IP Precedence Priority
IP Precedence Priority Table
IP Precedence 0 - Cos 0
IP Precedence 1 - Cos 0
IP Precedence 2 - Cos 1
IP Precedence 3 - Cos 1
IP Precedence 4 - Cos 2
IP Precedence 5 - Cos 2
IP Precedence 6 - Cos 3
IP Precedence 7 - Cos 3
Class of Service Queue (0-3)
Restore Default

Figure 4-10-8 IP Precedence Priority page screenshot

The page includes the following fields:

Object	Description
IP Precedence Priority Table	Shows the IP Precedence to CoS map.
Class of Queue Service Value	Maps an IP Precedence value to a CoS queue. Note that queue "**0**" represents low priority and "**3**" represent high priority.

4.10.2.7 Mapping IP TOS Priority

The **Type of Service (TOS)** octet in the IPv4 header is divided into three parts; Precedence (3 bits), TOS (4 bits), and MBZ (1 bit). The Precedence bits indicate the importance of a packet, whereas the TOS bits indicate how the network should make tradeoffs between throughput, delay, reliability, and cost (as defined in RFC 1394). The MBZ bit (for "must be zero") is currently unused and is either set to zero or just ignored.

0	1	2	3	4	5	6	7
Precedence			**TOS**				**MBZ**

Pv4 Packet Header Type of Service Octet

The four TOS bits provide 15 different priority values, however only five values have a defined meaning. The following table lists the defined IP TOS values and the default mapping to CoS queues on the switch. (All the TOS values not defined are mapped to CoS queue 0.)

IP TOS Value	Requested Service	Default CoS Output Queue
0	Normal service	0
1	Minimize monetary cost	0
2	Maximize reliability	1
4	Maximize throughput	2
8	Minimize delay	3

Table 4-10-5 Mapping IP TOS Values to CoS Priority Queues

1. Click QoS, Priority, **IP TOS Priority Status**.
2. Set the IP TOS Priority Status to **Enabled**.
3. Click QoS, Priority, **IP TOS Priority**.
4. Select an IP TOS value in the IP TOS Priority Table, enter a queue number in the Class of Queue Service Value field, and then click Apply.

4.10.2.8 IP TOS Priority Status

Figure 4-10-9 IP TOS Priority Status page screenshot

The page includes the following fields:

Object	Description
IP TOS Priority Status	**Enables** or **disables** the IP TOS priority.

4.10.2.9 IP TOS Priority

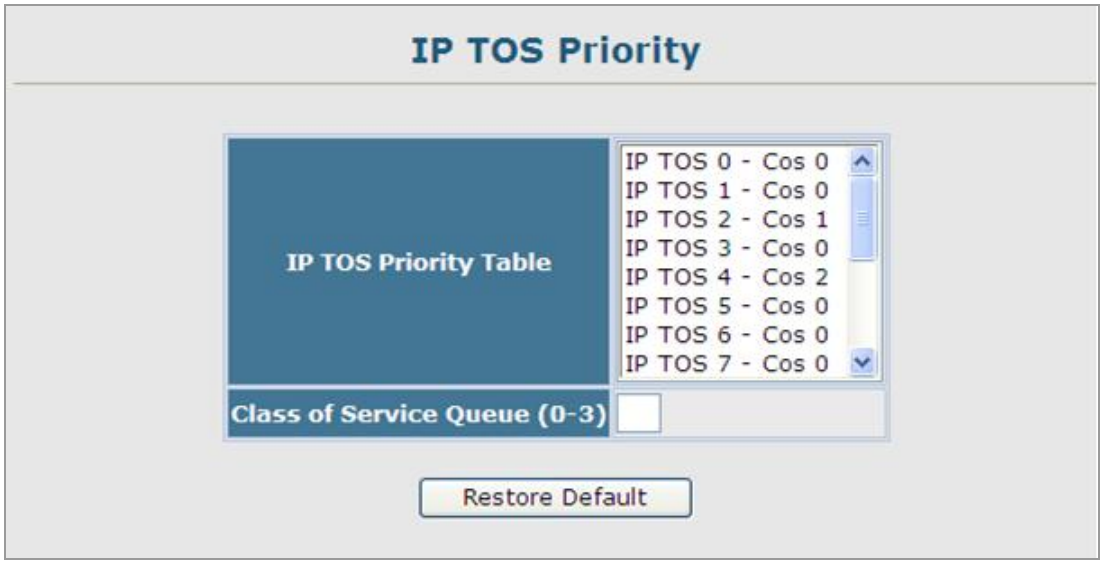

IP TOS Priority
IP TOS Priority Table
IP TOS 0 - Cos 0
IP TOS 1 - Cos 0
IP TOS 2 - Cos 1
IP TOS 3 - Cos 0
IP TOS 4 - Cos 2
IP TOS 5 - Cos 0
IP TOS 6 - Cos 0
IP TOS 7 - Cos 0
Class of Service Queue (0-3)
Restore Default

Figure 4-10-10 IP TOS Priority page screenshot

The page includes the following fields:

Object	Description
IP TOS Priority Table	Shows the IP TOS to CoS map.
Class of Queue Service Value	Maps an IP TOS value to a CoS queue. Note that queue "**0**" represents low priority and "**3**" represent high priority.

4.10.2.10 Mapping IP Port Priority

You can also map network applications to Class of Service queues based on the **IP port number** (i.e., **TCP/UDP port number**) in the frame header. Some of the more common TCP service ports include: HTTP: 80, FTP: 21, Telnet: 23 and POP3: 110.

1. Click QoS, Priority, **IP Port Priority Status**.
2. Set IP Port Priority Status to **Enabled**.
3. Click QoS, Priority, **IP Port Priority**.
4. Enter the **port number** for a network application in the IP Port Number box and the new CoS queue in the Class of Queue Service box, and then click Apply.

4.10.2.11 IP Port Priority Status

Figure 4-10-11 IP Port Priority Status page screenshot

The page includes the following fields:

Object	Description
IP Port Priority Status	Enables or disables the IP port priority.
IP Port Priority Table	Shows the IP port to CoS queue map.
IP Port Number (TCP/UDP)	Set a new IP port number.
Class of Queue Service Value	Sets a CoS queue for a new IP port. Note that "**0**" represents low priority and "**3**" represent high priority.

Note

IP Port Priority settings apply to all interfaces.

4.10.2.12 IP Port Priority

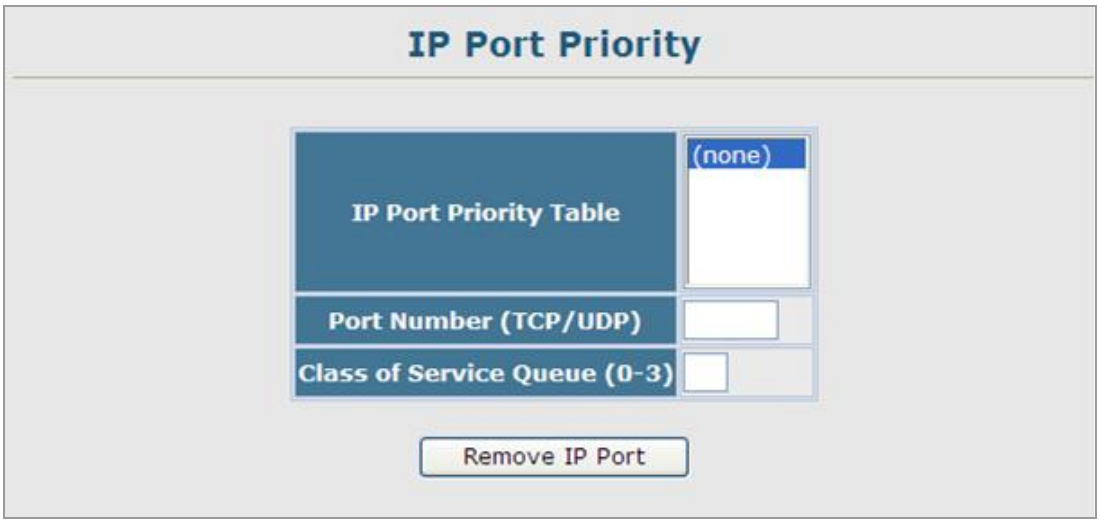


Figure 4-10-12 IP Port Priority page screenshot

The page includes the following fields:

Object	Description
IP Port Priority Table	Shows the IP port to CoS queue map.
IP Port Number (TCP/UDP)	Set a new IP port number.
Class of Queue Service Value	Sets a CoS queue for a new IP port. Note that "**0**" represents low priority and "**3**" represent high priority.

4.10.2.13 Mapping CoS Values to ACLs

Use the ACL CoS Mapping page to set the output queue for packets matching an ACL rule as shown in the following table. Note that the specified CoS value is only used to map the matching packet to an output queue; it is not written to the packet itself.

Priority	0	1	2	3	4	5	6	7
Queue	1	2	0	3	4	5	6	7

4.10.2.14 ACL CoS Priority

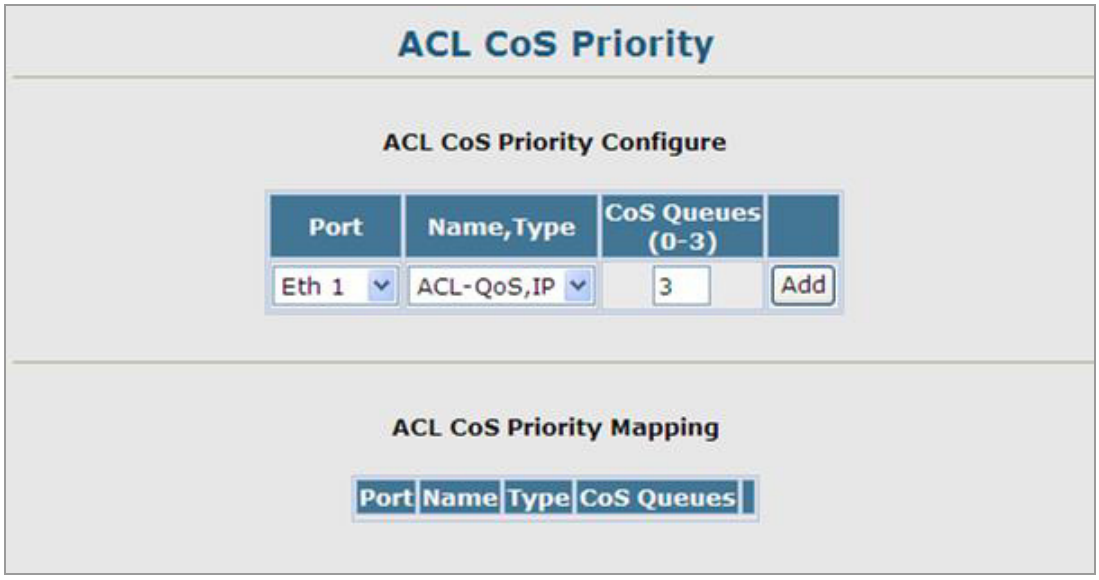


Figure 4-10-13 ACL CoS Priority page screenshot

The page includes the following fields:

Object	Description
Port	Port identifier.
Name	Name of a configured ACL.
Type	Type of ACL (IP or MAC).
CoS Values	CoS values used for packets matching the ACL rule. (Range: 0-7)

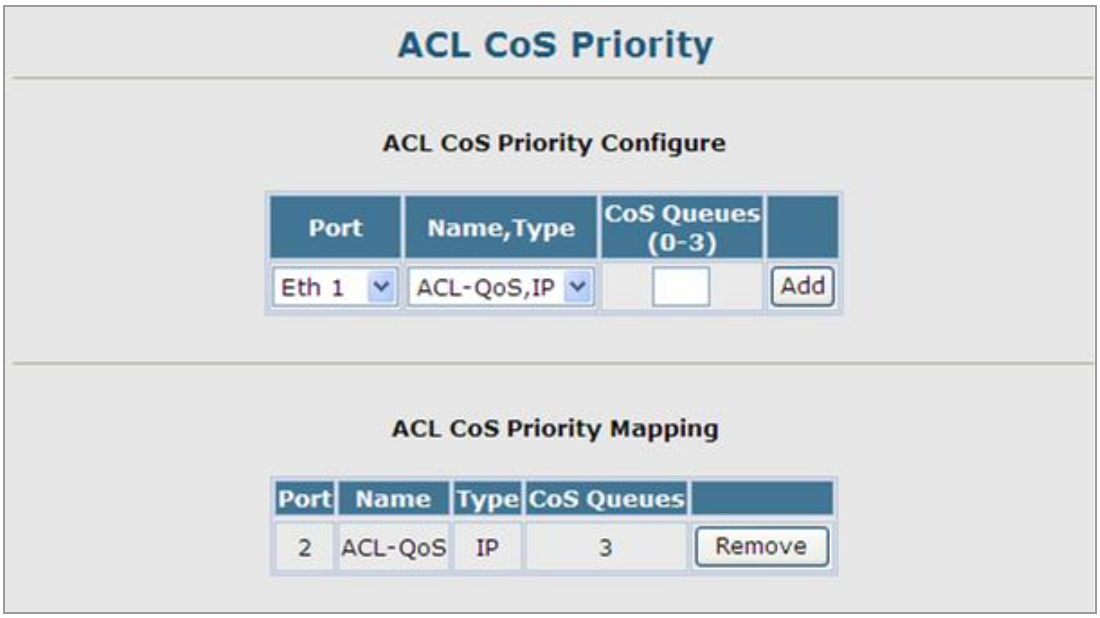


Figure 4-10-14 ACL CoS Priority page screenshot

4.10.3 DiffServ

The commands described in this section are used to configure **Quality of Service (QoS)** classification criteria and service policies. **Differentiated Services (DiffServ)** provides **policy-based** management mechanisms used for prioritizing network resources to meet the requirements of specific traffic types on a per hop basis. Each packet is classified upon entry into the network based on **access lists**, **IP Precedence**, **DSCP values**, or **VLAN lists**. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet. Based on configured network policies, different kinds of traffic can be marked for different kinds of forwarding.

All switches or routers that access the Internet rely on class information to provide the same forwarding treatment to packets in the same class. Class information can be assigned by end hosts, or switches or routers along the path. Priority can then be assigned based on a general policy, or a detailed examination of the packet. However, note that detailed examination of packets should take place close to the network edge so that core switches and routers are not overloaded.

Switches and routers along the path can use class information to prioritize the resources allocated to different traffic classes. The manner in which an individual device handles traffic in the DiffServ architecture is called per-hop behavior. All devices along a path should be configured in a consistent manner to construct a consistent end-to-end QoS solution.

1. You can configure up to **16 rules** per Class Map. You can also include multiple classes in a Policy Map.
2. You should create a Class Map before creating a Policy Map. Otherwise, you will not be able to select a Class Map from the Policy Rule Settings screen.

Configuring Quality of Service Parameters

To create a service policy for a specific category or ingress traffic, follow these steps:

1. Use the "**Class Map**" to designate a class name for a specific category of traffic.
2. Edit the **rules** for each class to specify a type of traffic based on an access list, a DSCP or IP Precedence value, or a VLAN.
3. Use the "**Policy Map**" to designate a policy name for a specific manner in which ingress traffic will be handled.
4. Add one or more classes to the **Policy Map**. Assign policy rules to each class by "setting" the QoS value to be assigned to the matching traffic class. The policy rule can also be configured to monitor the average flow and burst rate, and drop any traffic that exceeds the specified rate, or just reduce the DSCP service level for traffic exceeding the specified rate.
5. Use the "**Service Policy**" to assign a policy map to a specific interface.

4.10.3.1 Configuring a DiffServ Class Map

A class map is used for matching packets to a specified class.

Command Usage

- To configure a Class Map, follow these steps:
  - Open the **Class Map** page, and click **Add Class**.
  - -When the **Class Configuration** page opens, fill in the "**Class Name**" field, and click **Add**.
  - When the **Match Class Settings** page opens, specify type of traffic for this class based on an access list, and click the **Add** button next to the field for the selected traffic criteria. You can specify up to 16 items to match when assigning ingress traffic to a class map.
- The class map is used with a **policy map** to create a **service policy** for a specific interface that defines packet classification, service tagging, and bandwidth policing. Note that one or more class maps can be assigned to a policy map.

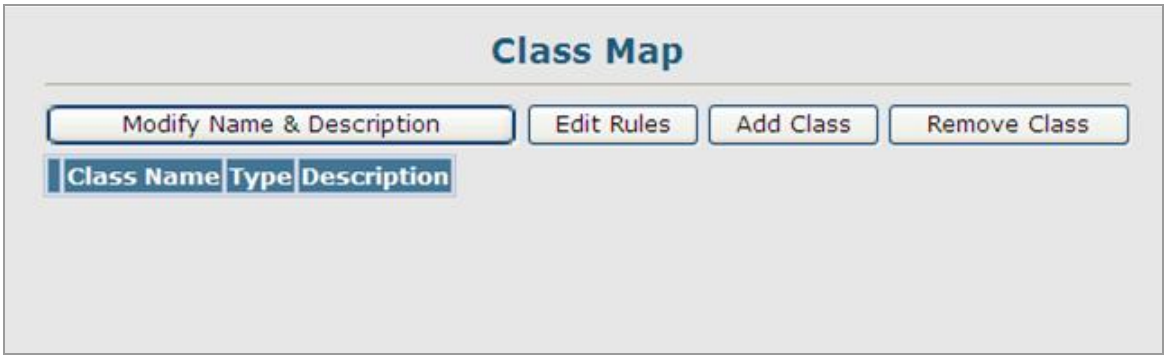


Figure 4-10-15 Class Map page screenshot

The page includes the following fields:

Object	Description
Modify Name and Description	Configures the name and a brief description of a class map. (Range: 1-16 characters for the name; 1-64 characters for the description)
Edit Rules	Opens the "**Match Class Settings**" page for the selected class entry. Modify the criteria used to classify ingress traffic on this page.
Add Class	Opens the "**Class Configuration**" page. Enter a class name and description on this page, and click Add to open the "**Match Class Settings**" page. Enter the criteria used to classify ingress traffic on this page.
Remove Class	Removes the selected class.

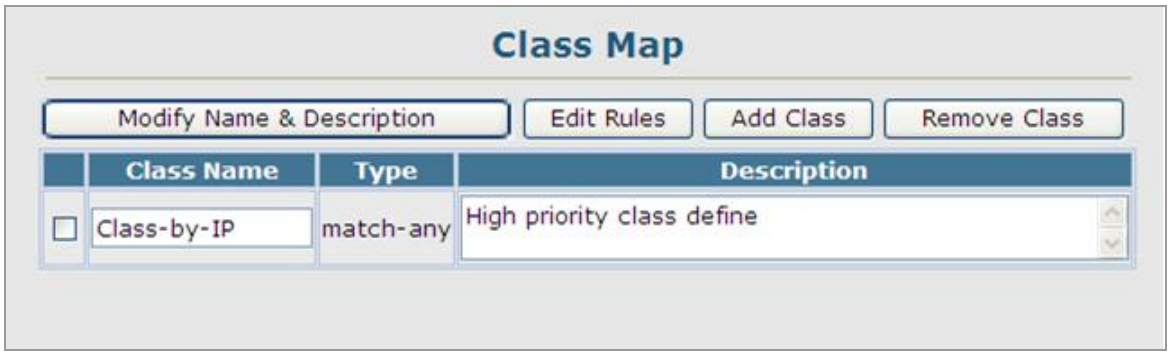


Figure 4-10-16 Class Map page screenshot

Class Configuration

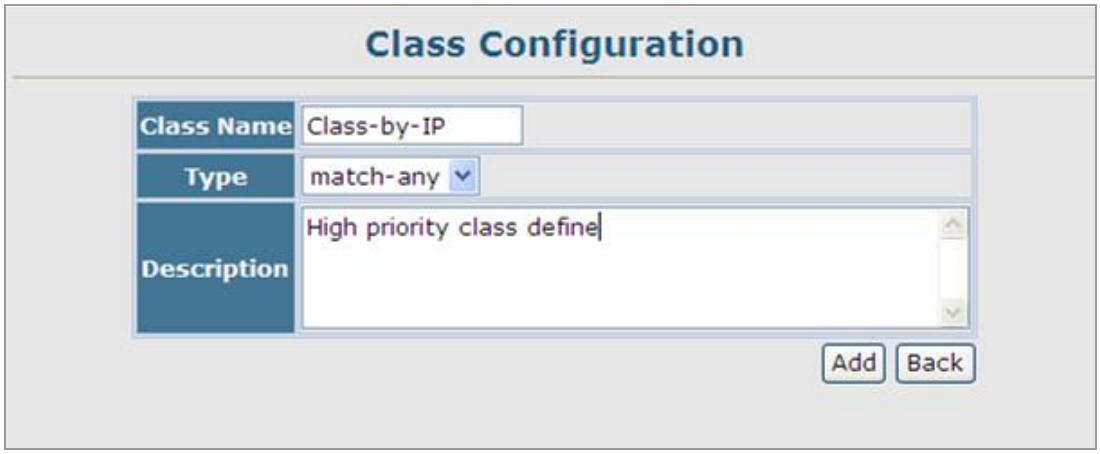


Figure 4-10-17 Class Configuration page screenshot

The page includes the following fields:

Object	Description
Class Name	Name of the class map. (Range: 1-16 characters)
Type	Only one match command is permitted per class map, so the match-any field refers to the criteria specified by the lone match command.
Description	A brief description of a class map. (Range: 1-64 characters)
Add	Adds the specified class.
Back	Returns to previous page with making any changes.

Match Class Settings

Figure 4-10-18 Match Class Settings page screenshot

The page includes the following fields:

Object	Description
Class Name	List of class maps
ACL List	Name of an access control list. Any type of ACL can be specified, including standard or extended IP ACLs and MAC ACLs. (Range: 1-16 characters)
Add	Adds specified criteria to the class. Up to **16** items are permitted per class.
Remove	Deletes the selected criteria from the class.

Figure 4-10-19 Standard ACL page screenshot

4.10.3.2 Policy Map

Creating QoS Policies

This function creates a policy map that can be attached to multiple interfaces.

Command Usage

- To configure a Policy Map, follow these steps:
  - Create a **Class Map** as described on.
  - Open the **Policy Map** page, and click **Add Policy**.
  - When the **Policy Configuration** page opens, fill in the **"Policy Name**" field, and click **Add**.
  - When the **Policy Rule Settings** page opens, select a class name from the scroll-down list (Class Name field). Configure a policy for traffic that matches criteria defined in this class by setting the quality of service that an IP packet will receive (in the Action field), defining the maximum throughput and burst rate (in the Meter field), and the action that results from a policy violation (in the Exceed field). Then finally click Add to register the new policy.

- A policy map can contain multiple class statements that can be applied to the same interface with the Service Policy Settings. You can configure up to 64 policers (i.e., meters or class maps) for each of the following access list types: MAC ACL, IP ACL (including Standard ACL and Extended ACL), IPv6 Standard ACL, and IPv6 Extended ACL. Also, note that the maximum number of classes that can be applied to a policy map is 16.

  Policing is based on a token bucket, where bucket depth (i.e., the maximum burst before the bucket overflows) is specified by the "Burst" field, and the average rate at which tokens are removed from the bucket is specified by the "Rate" option.

- After using the policy map to define packet classification, service tagging, and bandwidth policing, it must be assigned to a specific interface by a **service policy** to take effect.

1. Click QoS, DiffServ, **Policy Map** to display the list of existing policy maps.
2. To add a new policy map click **Add Policy**.
3. To configure the policy rule settings click **Edit Classes**.

Figure 4-10-20 Policy Map page screenshot

The page includes the following fields:

Object	Description
Modify Name and Description	Configures the name and a brief description of a policy map. (Range: 1-16 characters for the name; 1-64 characters for the description)
Edit Classes	Opens the "**Policy Rule Settings**" page for the selected class entry. Modify the criteria used to service ingress traffic on this page.
Add Policy	Opens the "**Policy Configuration**" page. Enter a policy name and description on this page, and click Add to open the "**Policy Rule Settings**" page. Enter the criteria used to service ingress traffic on this page.
Remove Policy	Deletes a specified policy.

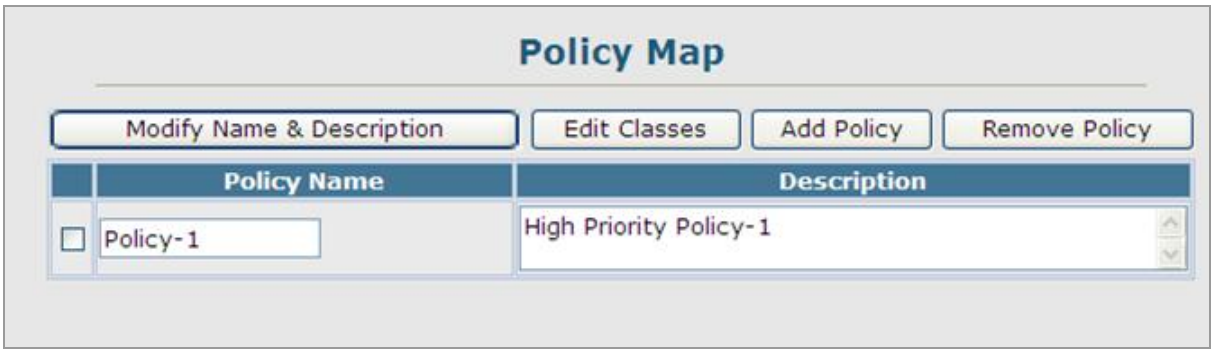


Figure 4-10-21 Policy Map page screenshot

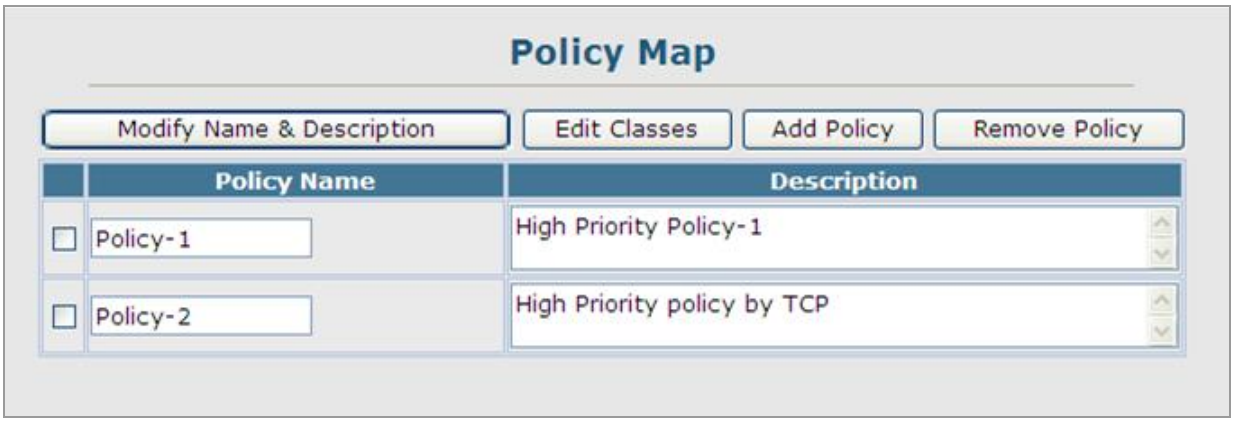


Figure 4-10-22 Policy Map page screenshot

Policy Configuration

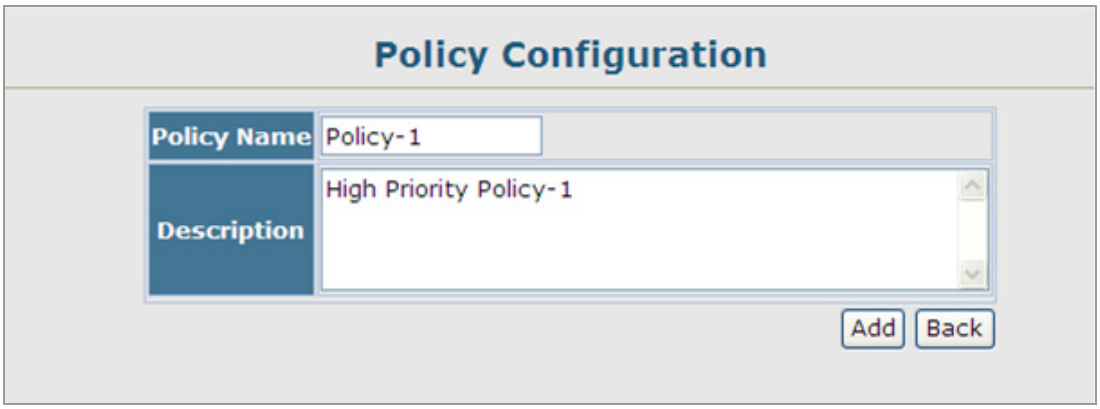


Figure 4-10-23 Policy Configuration page screenshot

The page includes the following fields:

Object	Description
Policy Name	Name of policy map. (Range: 1-16 characters)
Description	A brief description of a policy map. (Range: 1-64 characters)
Add	Adds the specified policy
Back	Returns to previous page with making any changes.

Policy Rule Settings

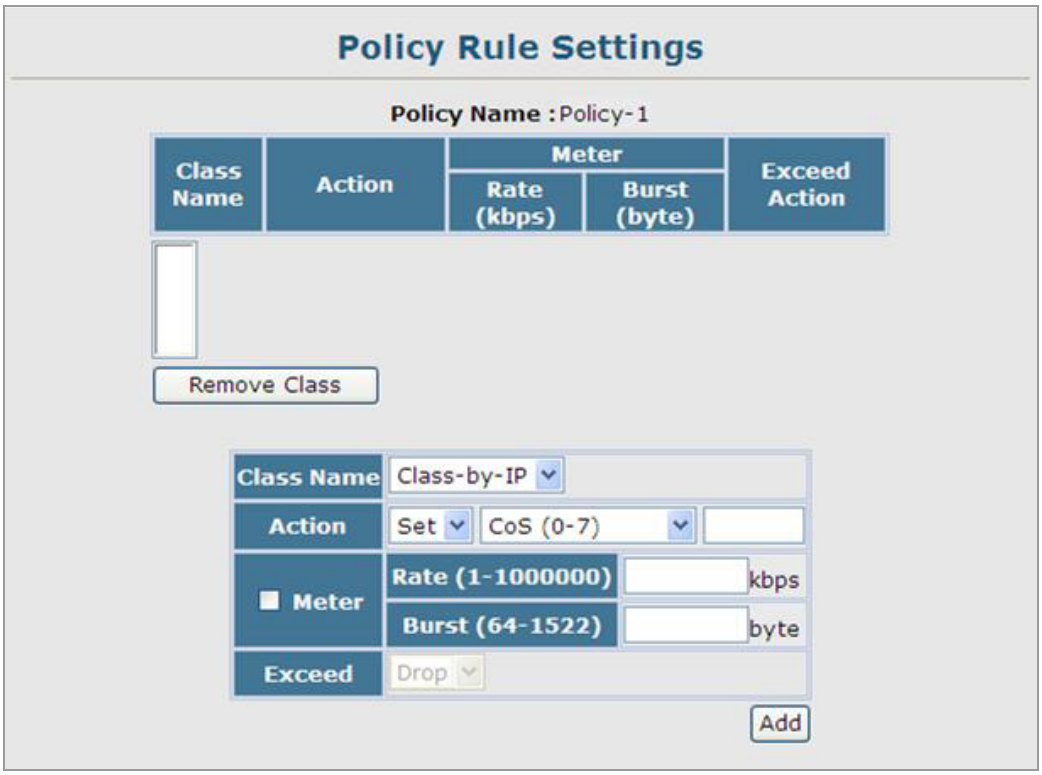


Figure 4-10-24 Policy Rule Settings page screenshot

The page includes the following fields:

Object	Description
Class Name	Name of class map.
Action	Shows the service provided to ingress traffic by setting a CoS or DSCP value in a matching packet (as specified in Match Class Settings). (Range - CoS: **0-7**, DSCP: **0-63**)
Meter	Check this to define the maximum throughput, burst rate, and the action that results from a policy violation - **Rate** (bps) Rate in kilobits per second. (Range: 1-100000 kbps or maximum port speed, whichever is lower) - **Burst** (byte) Burst in bytes. (Range: 64-1522)
Exceed Action	Specifies whether the traffic that exceeds the specified rate will be dropped.
Add	Adds the specified criteria to the policy map.
Remove Class	Deletes a class.

4.10.3.3 Service Policy

Attaching a Policy Map to Ingress Queues

This function binds a policy map to the ingress queue of a particular interface.

Command Usage

- You must first define a class map, then define a policy map, and finally bind the service policy to the required interface.
- You can only bind one policy map to an interface.
- The current firmware does not allow you to bind a policy map to an egress queue.

1. Click QoS, DiffServ, **Service Policy Settings**.
2. Check Enabled and choose a Policy Map for a port from the scroll-down box, then click Apply.

Figure 4-10-25 Service Policy Settings page screenshot

The page includes the following fields:

Object	Description
Ports	Specifies a port.
Ingress	Applies the rule to ingress traffic.
Enabled	Check this to enable a policy map on the specified port.
Policy Map	Select the appropriate policy map from the scroll-down box.

4.10.4 Voice VLANs

When IP telephony is deployed in an enterprise network, it is recommended to isolate the **Voice over IP (VoIP)** network traffic from other data traffic. Traffic isolation can provide higher voice quality by preventing excessive packet delays, packet loss, and jitter. This is best achieved by assigning all VoIP traffic to a single Voice VLAN.

The use of a Voice VLAN has several advantages. It provides security by isolating the VoIP traffic from other data traffic. End-to-end QoS policies and high priority can be applied to the VoIP VLAN traffic across the network, guaranteeing the bandwidth it needs. VLAN isolation also protects against disruptive broadcast and multicast traffic that can seriously affect voice quality.

The Managed Switch allows you to specify a Voice VLAN for the network and set a CoS priority for the VoIP traffic. VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using **LLDP (IEEE 802.1AB)** to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member the Voice VLAN. Alternatively, switch ports can be manually configured.

4.10.4.1 VoIP Traffic Configuration

To configure the switch for VoIP traffic, first enable the automatic detection of VoIP devices attached to Managed Switch ports, then set the Voice VLAN ID for the network. The Voice VLAN aging time can also be set to remove a port from the Voice VLAN when VoIP traffic is no longer received on the port.

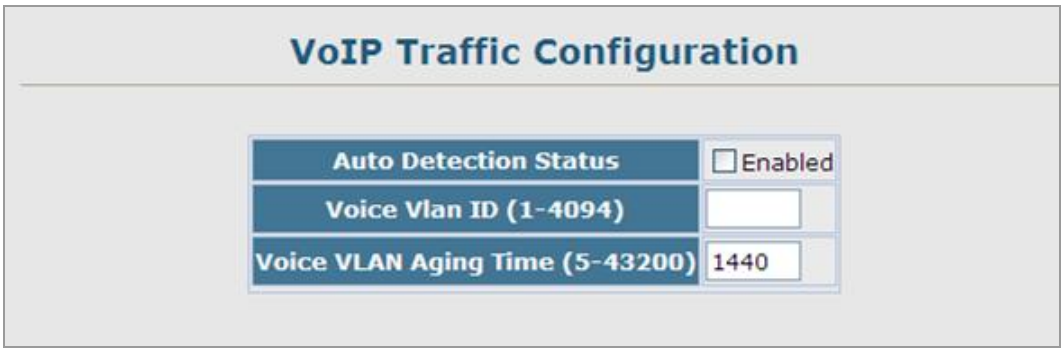


Figure 4-10-26 VoIP Traffic Configuration page screenshot

1. Click QoS, VoIP Traffic Setting, Configuration.
2. Enable Auto Detection, specify the Voice VLAN ID, the set the Voice VLAN Aging Time. Click Apply.

The page includes the following fields:

Object	Description
Auto Detection Status	Enables the automatic detection of VoIP traffic on switch ports. (Default: **Disabled**)

Voice VLAN ID	Sets the Voice VLAN ID for the network. Only one Voice VLAN is supported and it must already be created on the switch. (Range: 1-4094)
Vioce VLAN Aging Time	The time after which a port is removed from the Voice VLAN when VoIP traffic is no longer received on the port. (Range: 5-43200 minutes; Default: **1440** minutes).

The Voice VLAN ID cannot be modified when the global Auto Detection Status is enabled.

4.10.4.2 VoIP Port Configuration

To configure ports for VoIP traffic, you need to set the mode (Auto or Manual), specify the discovery method to use, and set the traffic priority. You can also enable security filtering to ensure that only VoIP traffic is forwarded on the Voice VLAN.

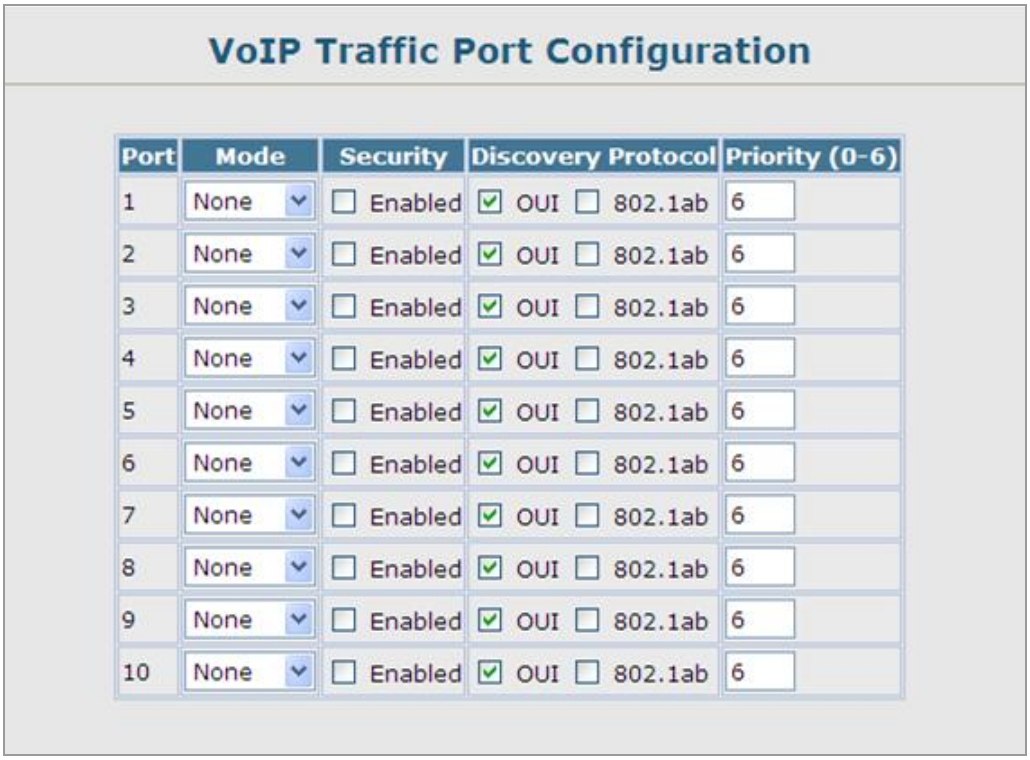

VoIP Traffic Port Configuration
Port
Mode
Security
Discovery Protocol
Priority (0-6)
1 None Enabled OUI 802.1ab 6
2 None Enabled OUI 802.1ab 6
3 None Enabled OUI 802.1ab 6
4 None Enabled OUI 802.1ab 6
5 None Enabled OUI 802.1ab 6
6 None Enabled OUI 802.1ab 6
7 None Enabled OUI 802.1ab 6
8 None Enabled OUI 802.1ab 6
9 None Enabled OUI 802.1ab 6
10 None Enabled OUI 802.1ab 6

Figure 4-10-27 VoIP Port Configuration page screenshot

The page includes the following fields:

Object	Description
Mode	Specifies if the port will be added to the Voice VLAN when VoIP traffic is detected. (Default: **None**)

	- None	The Voice VLAN feature is disabled on the port. The port will not detect VoIP traffic nor be added to the Voice VLAN.
	- Auto	The port will be added as a tagged member to the Voice VLAN when VoIP traffic is detected on the port. You must select a method for detecting VoIP traffic, either **OUI** or **802.1ab (LLDP)**. When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list.
	- Manual	The Voice VLAN feature is enabled on the port, but the port must be manually added to the Voice VLAN.
Security	Enables security filtering that discards any non-VoIP packets received on the port that are tagged with the voice VLAN ID. VoIP traffic is identified by source MAC addresses configured in the Telephony OUI list, or through LLDP that discovers VoIP devices attached to the switch. Packets received from non-VoIP sources are dropped. (Default: **Disabled**)	
Discovery Protocol	Selects a method to use for detecting VoIP traffic on the port. (Default: **OUI**)	
	- OUI	Traffic from VoIP devices is detected by the Organizationally Unique Identifier (OUI) of the source MAC address. OUI numbers are assigned to manufacturers and form the first three octets of a device MAC address. MAC address OUI numbers must be configured in the Telephony OUI list so that the switch recognizes the traffic as being from a VoIP device.
	- 802.1ab	Uses **LLDP** to discover VoIP devices attached to the port. LLDP checks that the "telephone bit" in the system capability TLV is turned on. See "Link Layer Discovery Protocol" for more information on LLDP.
Priority	Defines a CoS priority for port traffic on the Voice VLAN. The priority of any received VoIP packet is overwritten with the new priority when the Voice VLAN feature is active for a port.	

4.10.4.3 Telephony OUI Configuration

VoIP devices attached to the Managed Switch can be identified by the manufacturer's **Organizational Unique Identifier (OUI)** in the source MAC address of received packets. OUI numbers are assigned to manufacturers and form the first three octets of device MAC addresses. The MAC OUI numbers for VoIP equipment can be configured on the switch so that traffic from these devices is recognized as VoIP.

1. Click QoS, VoIP Traffic Setting, **Telephony OUI List**.
2. Enter a **MAC address** that specifies the OUI for VoIP devices in the network.
3. Select a mask from the pull-down list to define a MAC address range.
4. Enter a description for the devices, and then click **Add**.

Figure 4-10-28 Telephony OUI List page screenshot

The page includes the following fields:

Object	Description
Telephony OUI	Specifies a MAC address range to add to the list. Enter the MAC address in format 01-23-45-67-89-AB.
Mask	Identifies a range of MAC addresses. Selecting a mask of FF-FF-FF-00-00-00 identifies all devices with the same OUI (the first three octets). Other masks restrict the MAC address range. Selecting FF-FF-FF-FF-FF-FF specifies a single MAC address. (Default: **FF-FF-FF-00-00-00**)
Description	User-defined text that identifies the VoIP devices.

4.11 Security

This section is to control the access of the Managed Switch, includes the user access and management control.

The Security page contains links to the following main topics:

- **User Authentication**
- **Client Security**

4.11.1 User Authentication

You can configure this Managed Switch to authenticate users logging into the system for management access using local or remote authentication methods. Port-based authentication using IEEE 802.1X can also be configured to control either management access to the uplink ports or client access to the data ports.

This Managed Switch provides secure network management access4 using the following options:

- **User Accounts** – Manually configure access rights on the Managed Switch for specified users.
- **Authentication Settings** – Use remote authentication to configure access rights.
- **HTTPS Settings** – Provide a secure web connection.
- **SSH Settings** – Provide a secure shell (for secure Telnet access).
- **Port Security** – Configure secure addresses for individual ports.
- **802.1X** – Use IEEE 802.1X port authentication to control access to specific ports.
- **IP Filter** – Filters management access to the web, SNMP or Telnet interface.

4.11.1 Configuring User Accounts

The guest only has read access for most configuration parameters. However, the administrator has write access for all parameters governing the onboard agent. You should therefore assign a new administrator password as soon as possible, and store it in a safe place.

- The default guest name is "**guest**" with the password "**guest**."
- The default administrator name is "**admin**" with the password "**admin**."

1. Click Security, **User Accounts**.
2. To configure a new user account, specify a user name, select the user's access level, then enter a password and confirm it.
3. Click **Add** to save the new user account and add it to the **Account List**.
4. To change the password for a specific user, enter the **user name** and **new password**, confirm the password by entering it again, then click **Apply.**

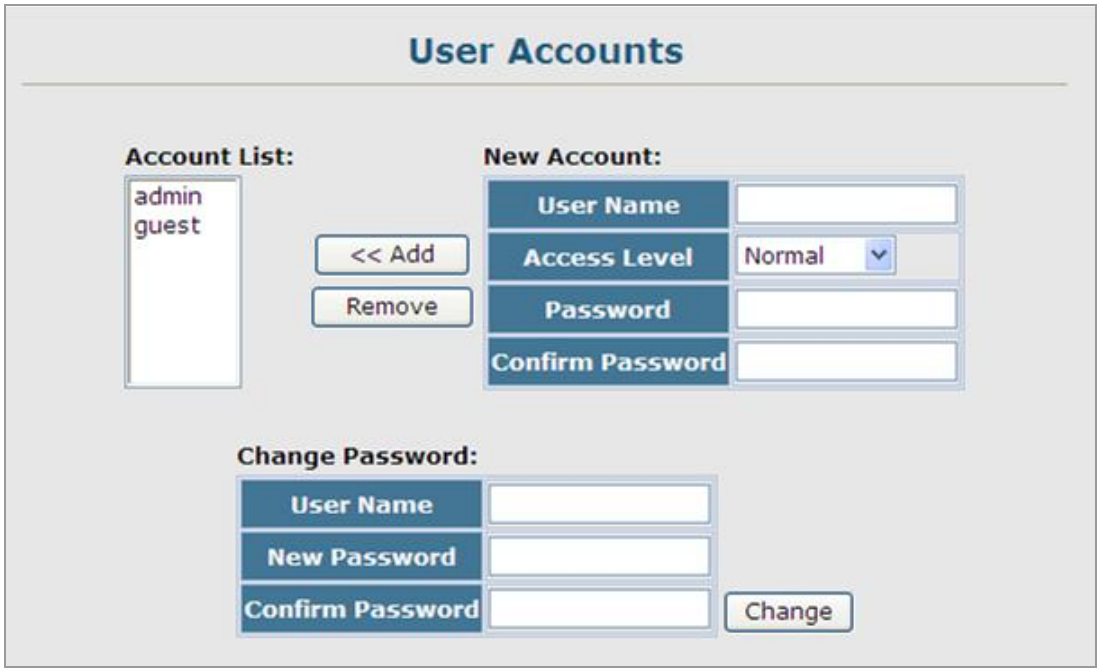


Figure 4-11-1 User Accounts page screenshot

The page includes the following fields:

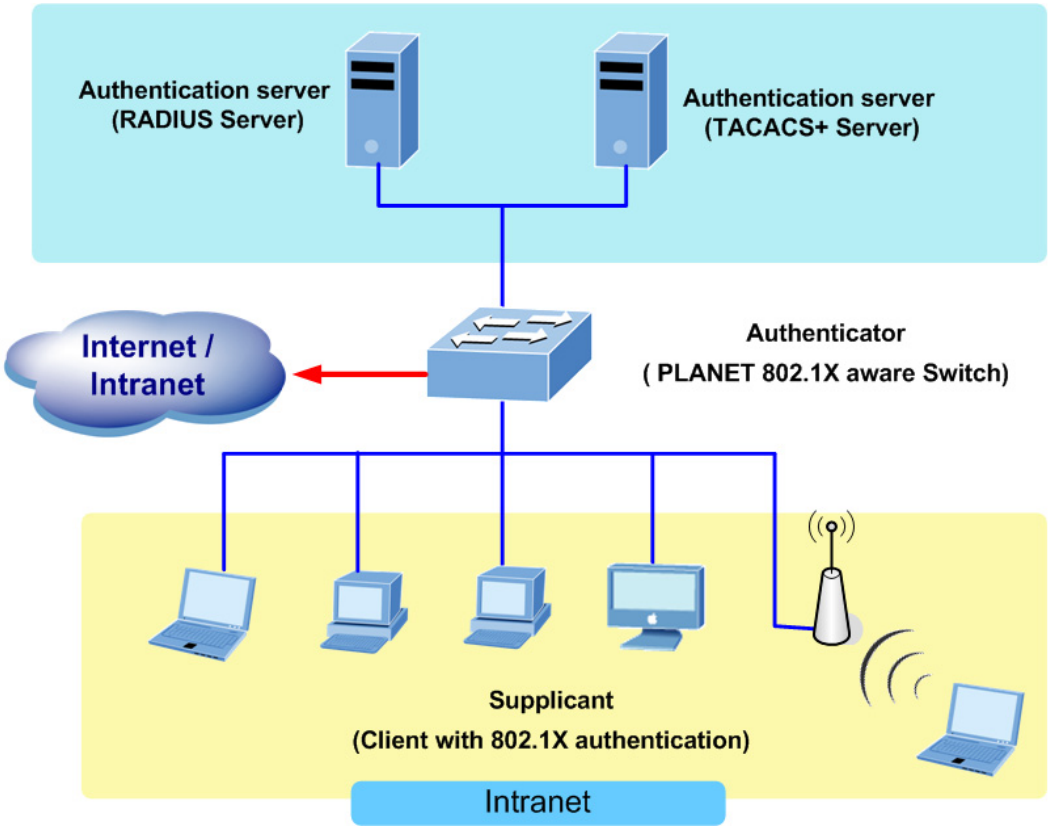
Object	Description
Account List	Displays the current list of user accounts and associated access levels. (Defaults: **admin**, and **guest**)
New Account	Displays configuration settings for a new account. **-User Name** The name of the user. Maximum length: **8** characters; Maximum number of users: **16** **-Access Level** Specifies the user level. Options: • **Normal** • **Privileged** **-Password** Specifies the user password. (Range: 0-8 characters plain text, case sensitive)
Change Password	Sets a new password for the specified user name.
Add / Remove	Adds or removes an account from the list.

4.11.2 Configuring Local / Remote Logon Authentication

Use the Authentication Settings menu to restrict management access based on specified user names and passwords. You can manually configure access rights on **the Managed Switch**, or you can use a remote access authentication server based on **RADIUS** or **TACACS+** protocols.

Remote Authentication Dial-in User Service (RADIUS) and **Terminal Access Controller Access Control System Plus (TACACS+)** are logon authentication protocols that use software running on a central server to control access to RADIUS-aware or TACACS-aware devices on the network. An **authentication server** contains a database of multiple user name/password pairs with associated privilege levels for each user that requires management access to the Managed Switch.

RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.



Command Usage

- By default, management access is always checked against the authentication database stored on the local switch. If a remote authentication server is used, you must specify the authentication sequence and the corresponding parameters for the remote authentication protocol. Local and remote logon authentication control management access via the console port, web browser, or Telnet.

- **RADIUS** and **TACACS+** logon authentication assign a specific privilege level for each user name/password pair. The user name, password, and privilege level must be configured on the authentication server. The encryption methods used for the authentication process must also be configured or negotiated between the authentication server and logon client. This switch can pass authentication messages between the server and client that have been encrypted using :
  - **MD5 (Message-Digest 5)**,
  - **TLS (Transport Layer Security)**
  - **TTLS (Tunneled Transport Layer Security).**
- You can specify up to three authentication methods for any user to indicate the authentication sequence. For example, if you select (1) RADIUS, (2) TACACS and (3) Local, the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted using the TACACS+ server, and finally the local user name and password is checked.

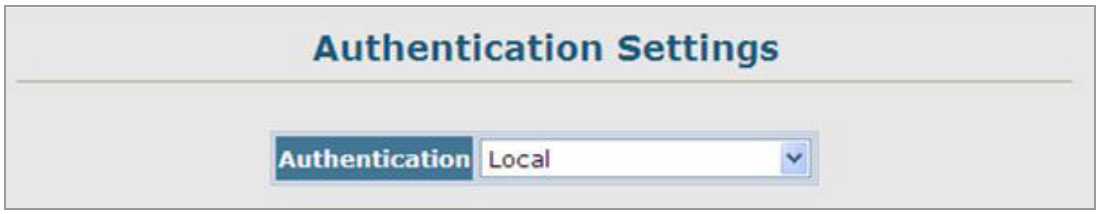


Figure 4-11-2 Authentication Settings page screenshot

The page includes the following fields:

Object	Description
Authentication	Select the authentication, or authentication sequence required: **- Local** User authentication is performed only locally by the switch. **- Radius** User authentication is performed using a RADIUS server only. **- TACACS** User authentication is performed using a TACACS+ server only. –**[authentication sequence] -** User authentication is performed by up to three Authentication methods in the indicated sequence.

4.11.3 RADIUS Settings

This page is to configure the RADIUS server connection session parameters. The RADIUS Settings screen in Figure 4-11-3 appears.

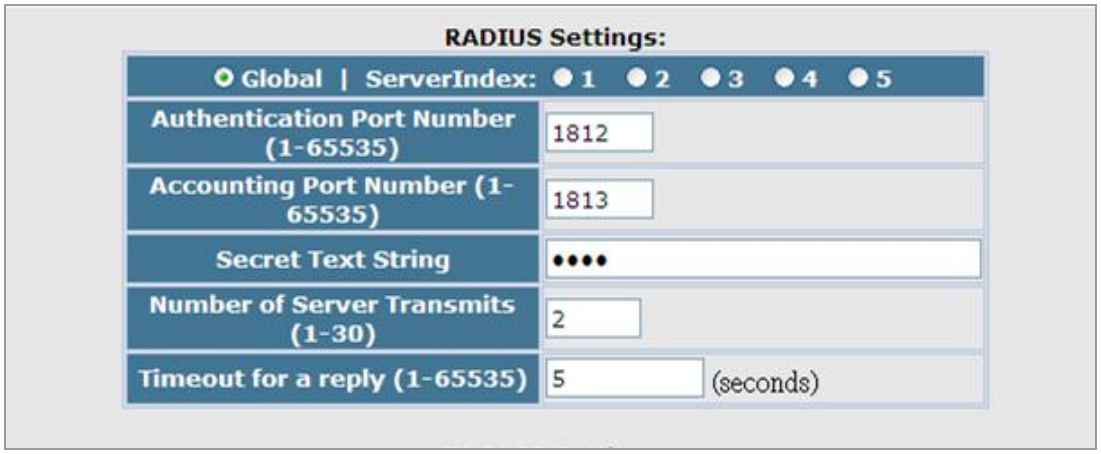


Figure 4-11-3 Authentication \ RADIUS Settings screenshot

The page includes the following fields:

Object	Description
RADIUS Settings -Global	Provides globally applicable RADIUS settings.
ServerIndex	Specifies one of five RADIUS servers that may be configured. The Managed Switch attempts authentication using the listed sequence of servers. The process ends when a server either approves or denies access to a user.
Server IP Address	Address of the RADIUS server.
Server Port Number	Network (UDP) port of authentication server used for authentication messages. Range: 1-65535; Default: **1812**
Secret Text String	Encryption key used to authenticate logon access for client. Do not use blank spaces in the string. (Maximum length: 48 characters)
Number of Server Transmits	Number of times the Managed Switch tries to authenticate logon access via the authentication server. Range: 1-30; Default: **2**
Timeout for a reply	The number of seconds the Managed Switch waits for a reply from the RADIUS server before it resends the request. Range: 1-65535; Default: **5**

4.11.4 TACACS Settings

This page is to configure the TACACS server connection session parameters. The TACACS Settings screen in Figure 4-11-4 appears.

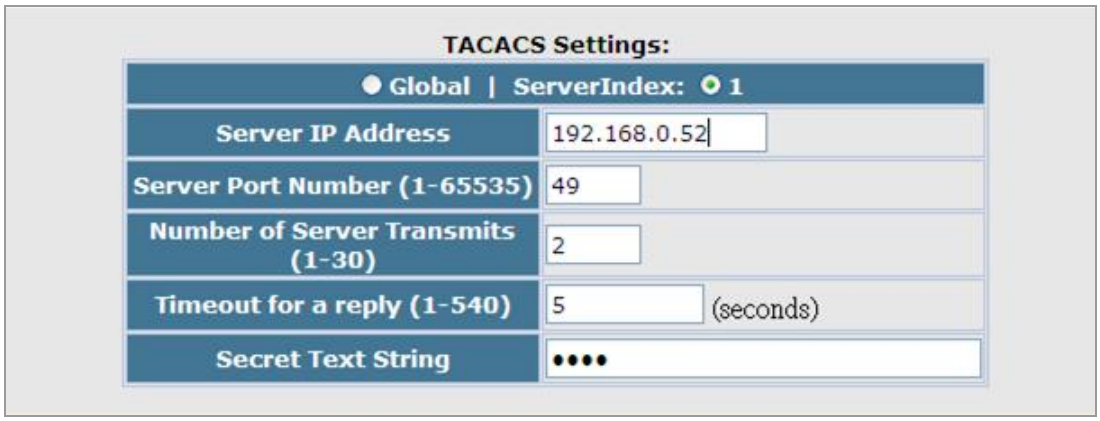


Figure 4-11-4 Authentication \ TACACS Settings screenshot

The page includes the following fields:

Object	Description
TACACS Settings -Global	Provides globally applicable TACACS+ settings.
ServerIndex	Specifies the index number of the server to be configured. The switch currently supports only one TACACS+ server.
Server IP Address	Address of the TACACS+ server.
Server Port Number	Network (TCP) port of TACACS+ server used for authentication messages. (Range: 1-65535; Default: **49**)
Number of Server Transmits	Number of times the switch attempts to send an authentication request to the server. (Range: 1-30; Default: **2**)
Timeout for a reply	The number of seconds the switch waits for a reply from the server before it resends the request. (Range: 1-540 seconds; Default: **5**)
Secret Text String	Encryption key used to authenticate logon access for client. Do not use blank spaces in the string. (Maximum length: 48 characters)

The local switch user database has to be set up by manually entering user names and passwords using the CLI. (See "username")

4.11.5 AAA Authorization and Accounting

Authentication, authorization, and accounting (AAA) provides a framework for configuring access control on the Managed Switch. The three security functions can be summarized as follows:

- **Authentication** — Identifies users that request access to the network.
- **Authorization** — Determines if users can access specific services.
- **Accounting** — Provides reports, auditing, and billing for services that users have accessed on the network.

The AAA functions require the use of configured RADIUS or TACACS+ servers in the network. The security servers can be defined as sequential groups that are then applied as a method for controlling user access to specified services. For example, when the switch attempts to authenticate a user, a request is sent to the first server in the defined group, if there is no response the second server will be tried, and so on. If at any point a pass or fail is returned, the process stops.

The Managed Switch supports the following AAA features:

- Accounting for **IEEE 802.1X authenticated users** that access the network through the Managed Switch.
- Accounting for users that access **management interfaces** on the Managed Switch through the console and Telnet.
- Accounting for **commands** that users enter at specific CLI privilege levels. Authorization of users that access management interfaces on the Managed Switch through the console and Telnet.

To configure AAA on the Managed Switch, you need to follow this general process:

1. Configure RADIUS and TACACS+ server access parameters. See "**Configuring Local/Remote Logon Authentication**".
2. Define RADIUS and TACACS+ server groups to support the accounting and authorization of services.
3. Define a method name for each service to which you want to apply accounting or authorization and specify the RADIUS or TACACS+ server groups to use. Apply the method names to port or line interfaces.

This guide assumes that RADIUS and TACACS+ servers have already been configured to support AAA. The configuration of RADIUS and TACACS+ server software is beyond the scope of this guide, refer to the documentation provided with the RADIUS or TACACS+ server software.

4.11.5.1 RADIUS Group Settings

The AAA RADIUS Group Settings screen defines the configured RADIUS servers to use for accounting and authorization.

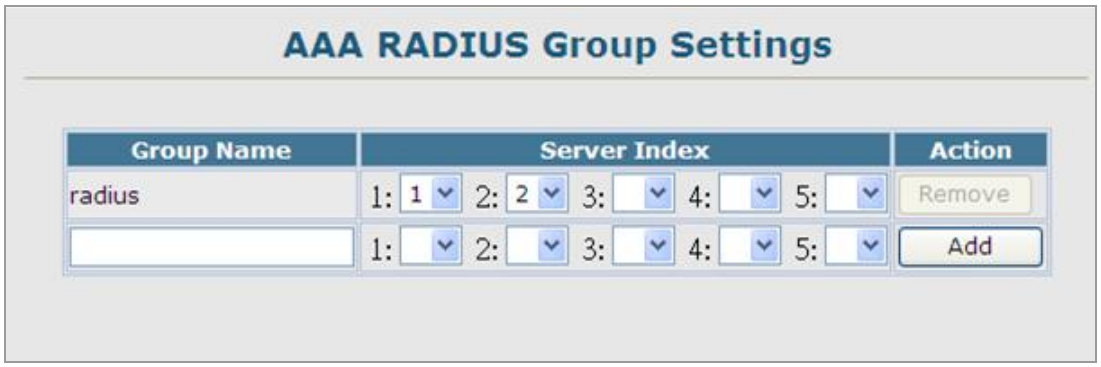


Figure 4-11-5 AAA \ AAA RADIUS Group Settings screenshot

1. Click Security, AAA, Radius Group Settings.
2. Enter the RADIUS group name, followed by the number of the server, then click Add.

The page includes the following fields:

Object	Description
Group Name	Defines a name for the RADIUS server group. (1-255 characters)
Server Index	Specifies a RADIUS server and the sequence to use for the group. (Range: 1-5)

When specifying the index for a RADIUS sever, the server index must already be defined (see "**Configuring Local/Remote Logon Authentication**").

4.11.5.2 AAA TACACS+ Group Settings

The AAA TACACS+ Group Settings screen defines the configured TACACS+ servers to use for accounting and authorization. When specifying the index for a TACACS+ server, the server index must already be defined (see "**Configuring Local/Remote Logon Authentication**").

1. Click Security, AAA, TACACS+ Group Settings.
2. Enter the TACACS+ group name, followed by the number of the server, then click Add.

Figure 4-11-6 AAA \ AAA RADIUS Group Settings screenshot

The page includes the following fields:

Object	Description
Group Name	Defines a name for the TACACS+ server group. (1-255 characters)
Server	Spefies the TACACS+ server to use for the group. (Range: 1)

4.11.5.3 AAA Accounting Settings

AAA accounting is a feature that enables the accounting of requested services for billing or security purposes.

AAA Accounting Settings
Method Name
Service Request
Accounting Notice
Group Name
Action
default 802.1X start-stop radius Remove
default EXEC start-stop tacacs+ Remove
default Commands 0 start-stop tacacs+ Remove
default Commands 1 start-stop tacacs+ Remove
default Commands 2 start-stop tacacs+ Remove
default Commands 3 start-stop tacacs+ Remove
default Commands 4 start-stop tacacs+ Remove
default Commands 5 start-stop tacacs+ Remove
default Commands 6 start-stop tacacs+ Remove
default Commands 7 start-stop tacacs+ Remove
default Commands 8 start-stop tacacs+ Remove
default Commands 9 start-stop tacacs+ Remove
default Commands 10 start-stop tacacs+ Remove
default Commands 11 start-stop tacacs+ Remove
default Commands 12 start-stop tacacs+ Remove
default Commands 13 start-stop tacacs+ Remove
default Commands 14 start-stop tacacs+ Remove
default Commands 15 start-stop tacacs+ Remove
802.1X Privilege Level (0-15) : start-stop Add

Figure 4-11-7 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Accounting, Settings. To configure a new accounting method, specify a method name and a group name, then click Add.

The page includes the following fields:

Object	Description
Method Name	Specifies an accounting method for service requests. The "default" methods are used for a requested service if no other methods have been defined. (Range: 1-255 characters) The method name is only used to describe the accounting method(s) configured on the specified accounting servers, and do not actually send any information to the servers about the methods to use.
Service Request	Specifies the service as either 802.1X (user accounting) or Exec (administrative accounting for local console, Telnet, or SSH connections).
Accounting Notice	Records user activity from log-in to log-off point.

Group Name	Specifies the accounting server group. (Range: 1-255 characters) The group names "radius" and "tacacs+" specifies all configured RADIUS and TACACS+ hosts (see "**Configuring Local/Remote Logon Authentication**"). Any other group name refers to a server group configured on the RADIUS or TACACS+ Group Settings pages.

4.11.5.4 AAA Accounting Update

This feature sets the interval at which accounting updates are sent to accounting servers.

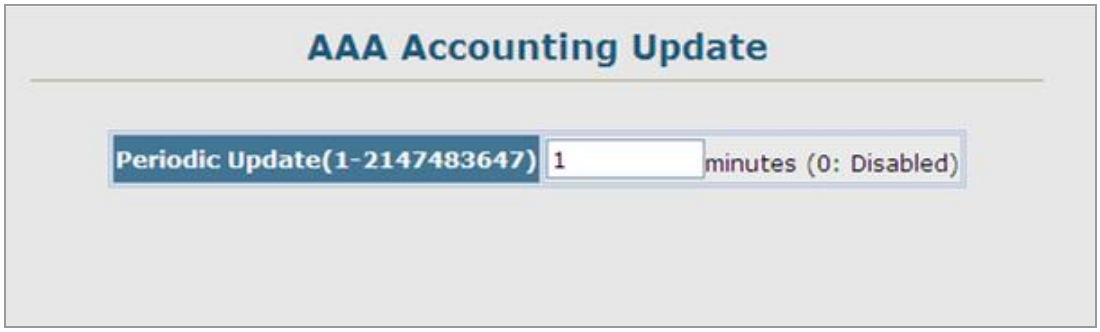


Figure 4-11-8 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Accounting, Periodic Update. Enter the required update interval and click Apply

The page includes the following fields:

Object	Description
Periodic Update	Specifies the interval at which the local accounting service updates information to the accounting server. Range: 1-2147483647 minutes; Default: **Disabled**

4.11.5.5 AAA Accounting 802.1X Port Settings

This feature applies the specified accounting method to an interface.

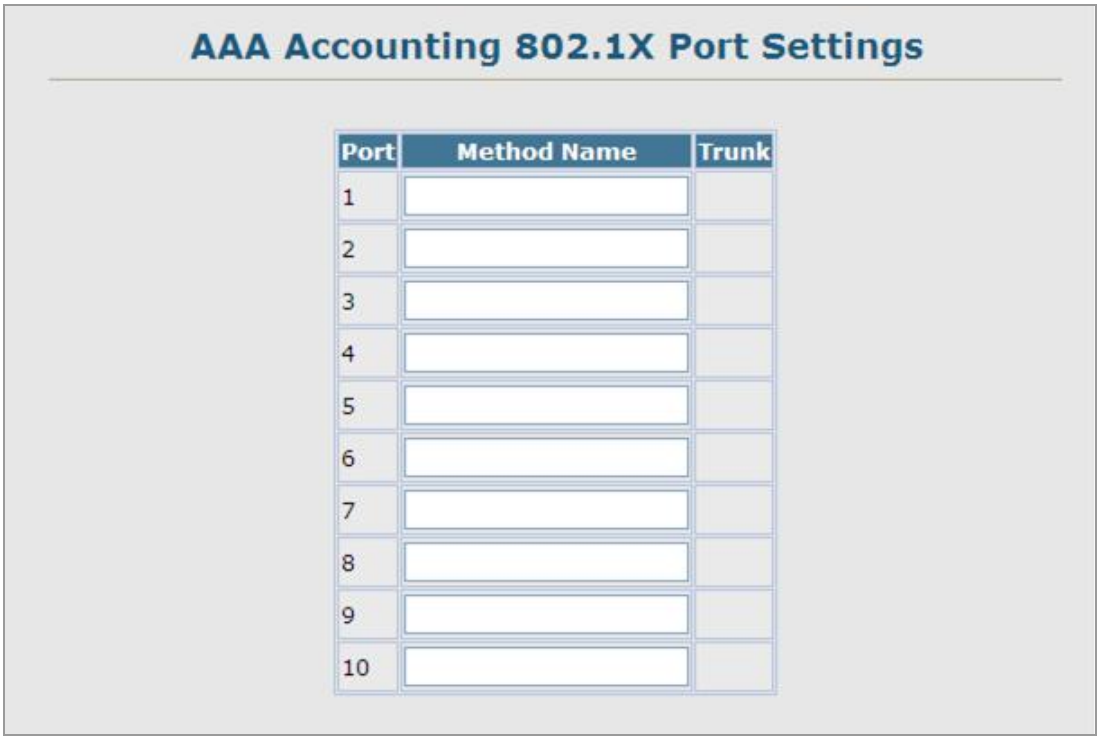


Figure 4-11-9 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Accounting, 802.1X Port Settings. Enter the required accounting method and click Apply.

The page includes the following fields:

Object	Description
Port/Trunk	Specifies a port or trunk number.
Method Name	Specifies a user defined method name to apply to the interface. This method must be defined in the **AAA Accounting Settings** menu. (Range: 1-255 characters)

4.11.5.6 AAA Accounting Exec Command Privileges

This feature specifies a method name to apply to commands entered at specific CLI privilege levels.

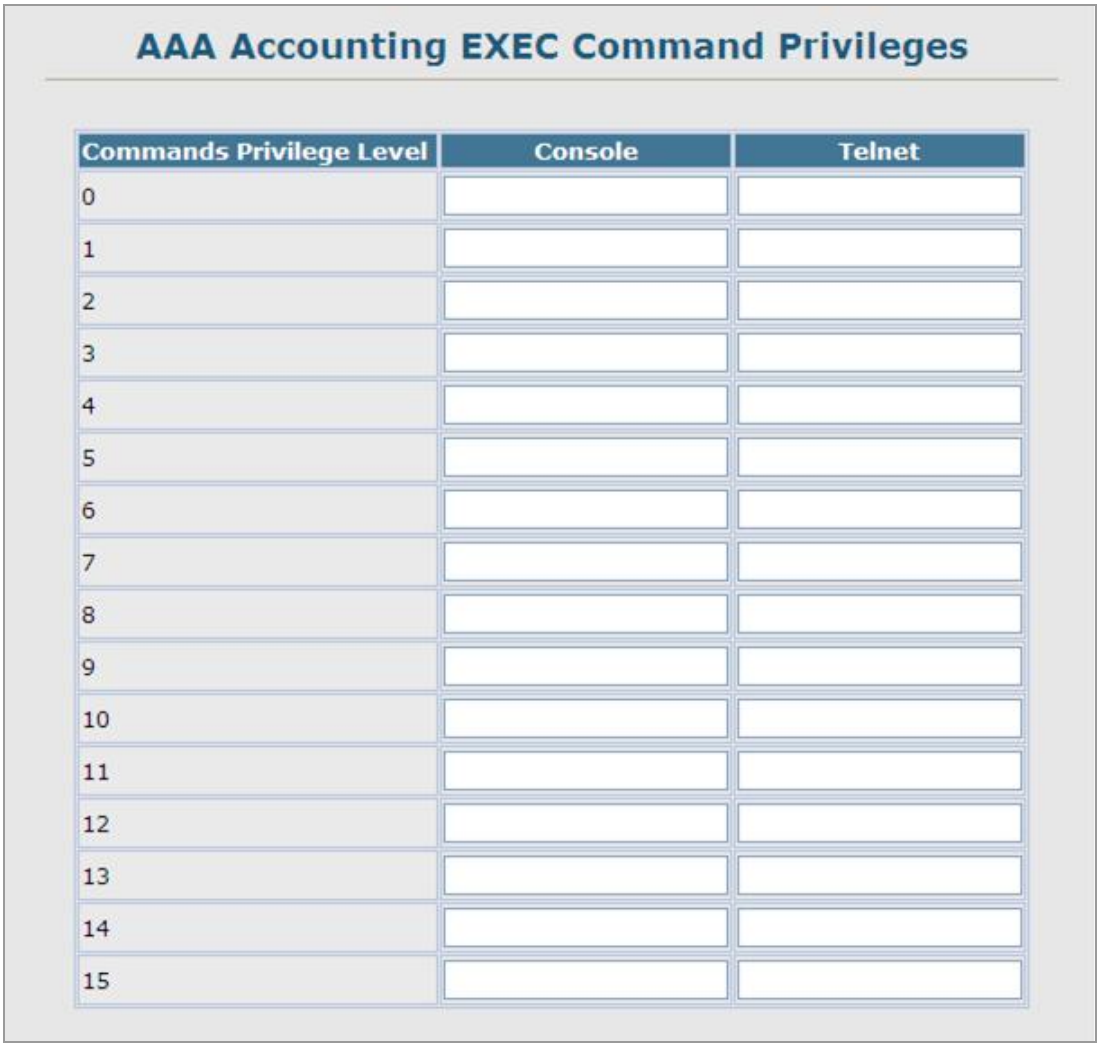


Figure 4-11-10 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Accounting, Command Privilges. Enter a defined method name for console and Telnet privilege levels. Click Apply.

The page includes the following fields:

Object	Description
Commands Privilege Level	The CLI privilege levels (0-15).
Console/Telnet	Specifies a user-defined method name to apply to commands entered at the specified CLI privilege level.

4.11.5.7 AAA Accounting EXEC Settings

This feature specifies a method name to apply to console and Telnet connections.

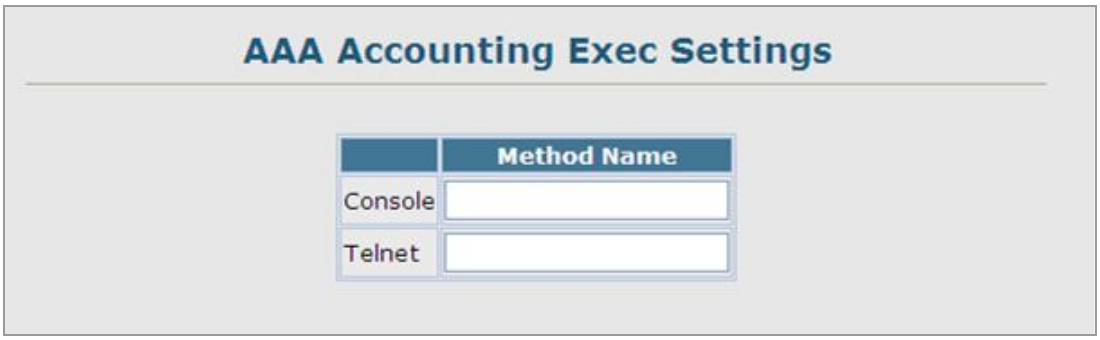


Figure 4-11-11 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Accounting, Exec Settings. Enter a defined method name for console and Telnet connections, and click Apply.

The page includes the following fields:

Object	Description
Method Name	Specifies a user defined method name to apply to console and Telnet connections.

4.11.5.8 AAA Accounting Summary

This feature displays all accounting configured accounting methods, the methods applied to specified interfaces, and basic accounting information recorded for user sessions.

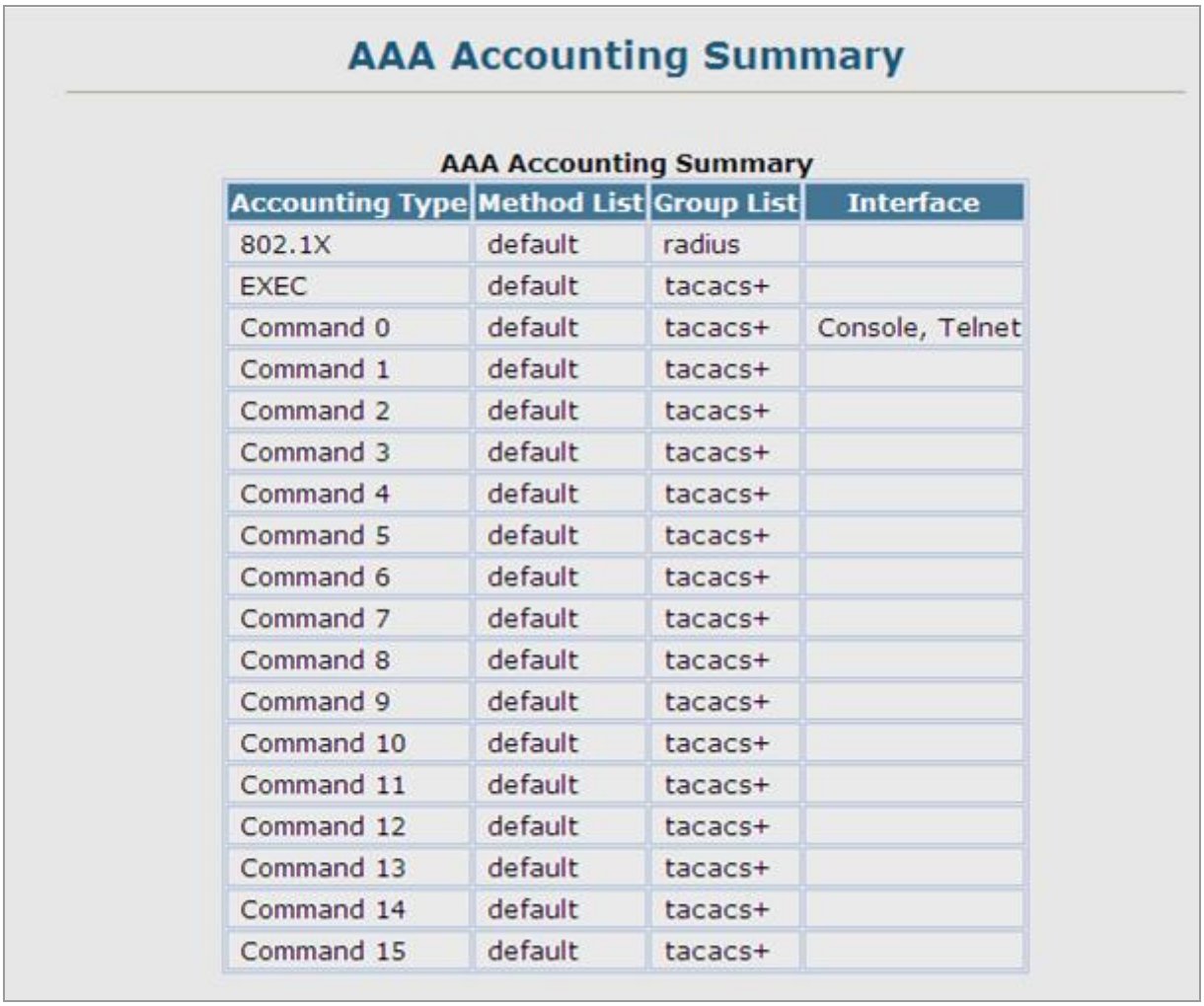

AAA Accounting Summary
AAA Accounting Summary
Accounting Type | Method List | Group List | Interface
802.1X | default | radius |
EXEC | default | tacacs+ |
Command 0 | default | tacacs+ | Console, Telnet
Command 1 | default | tacacs+ |
Command 2 | default | tacacs+ |
Command 3 | default | tacacs+ |
Command 4 | default | tacacs+ |
Command 5 | default | tacacs+ |
Command 6 | default | tacacs+ |
Command 7 | default | tacacs+ |
Command 8 | default | tacacs+ |
Command 9 | default | tacacs+ |
Command 10 | default | tacacs+ |
Command 11 | default | tacacs+ |
Command 12 | default | tacacs+ |
Command 13 | default | tacacs+ |
Command 14 | default | tacacs+ |
Command 15 | default | tacacs+

Figure 4-11-12 AAA \ AAA RADIUS Group Settings screenshot

The page includes the following fields:

4.11.5.9 AAA Accounting Summary

Object	Description
Accounting Type	Displays the accounting service.
Method List	Displays the user-defined or default accounting method.
Group List	Displays the accounting server group.
Interface	Displays the port or trunk to which these rules apply. (This field is null if the accounting method and associated server group has not been assigned to an interface.)

AAA Accounting Statistics Summary

Object	Description
User Name	Displays a registered user name.
Interface	Displays the receive port number through which this user accessed the switch.
Time Elapsed	Displays the length of time this entry has been active.

4.11.5.10 Authorization Settings

AAA authorization is used to verify that a user has access to specific services.

Figure 4-11-12 AAA \ AAA RADIUS Group Settings screenshot

Click Security, AAA, Authorization, Settings. To configure a new authorization method, specify a method name and a group name, select the service, then click Add.

The page includes the following fields:

Object	Description
Method Name	Specifies an authorization method for service requests. The "default" method is used for a requested service if no other methods have been defined. (Range: 1-255 characters)
Service Request	Specifies the service as Exec (authorization for local **console** or **Telnet** connections).
Group Name	Specifies the authorization server group. (Range: 1-255 characters)

	The group name "tacacs+" specifies all configured TACACS+ hosts (see "**Configuring Local/Remote Logon Authentication**"). Any other group name refers to a server group configured on the TACACS+ Group Settings page. Authorization is only supported for TACACS+ servers.

4.11.5.11 AAA Authorization EXEC Settings

This feature specifies an authorization method name to apply to console and Telnet connections.

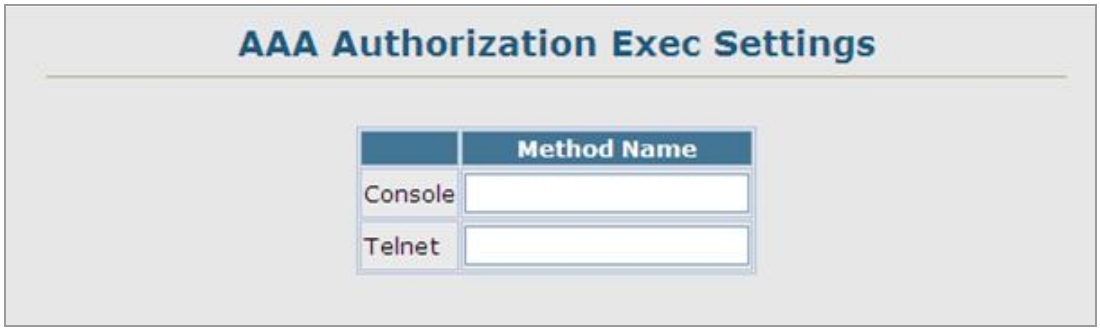


Figure 4-11-13 Settings screenshot

1. Click Security, AAA, Authorization, Exec Settings.
2. Enter a defined method name for console and Telnet connections, and click Apply.

The page includes the following fields:

Object	Description
Method Name	Specifies a user-defined method name to apply to **console** and **Telnet** connections.

4.11.5.12 AAA Authorization Summary

The Authorization Summary displays the configured authorization methods and the interfaces to which they are applied.

Figure 4-11-14 Settings screenshot

The page includes the following fields:

Object	Description
Authorization Type	Displays the authorization service.
Method List	Displays the user-defined or default authorization method.
Group List	Displays the authorization server group.
Interface	Displays the console or Telnet interface to which the authorization method applies. (This field is null if the authorization method and associated server group have not been assigned.)

4.11.6 HTTPS Setting

You can configure the switch to enable the Secure Hypertext Transfer Protocol (HTTPS) over the Secure Socket Layer (SSL), providing secure access (i.e., an encrypted connection) to the switch's web interface.

Command Usage

- Both the HTTP and HTTPS service can be enabled independently on the switch. However, you cannot configure both services to use the same UDP port. (HTTP can only be configured through the CLI using the ip http secure-server command described on page 4-106.)
- If you enable HTTPS, you must indicate this in the URL that you specify in your browser: https://device[:port_number]
- When you start HTTPS, the connection is established in this way:
  -The client authenticates the server using the server's digital certificate.
  -The client and server negotiate a set of security protocols to use for the connection.
  -The client and server generate session keys for encrypting and decrypting data.
- The client and server establish a secure encrypted connection. A padlock icon should appear in the status bar for Internet Explorer 5.x or above, Netscape 6.2 or above, and Mozilla Firefox 2.0.0.0 or above.
- The following web browsers and operating systems currently support HTTPS:

Web Browser	Operating System
Internet Explorer 5.0 or later	Windows 98,Windows NT (with service pack 6a), Windows 2000, Windows XP
Netscape 6.2 or later	Windows 98,Windows NT (with service pack 6a), Windows 2000, Windows XP, Solaris 2.6
Mozilla Firefox 2.0.0.0 or later	Windows 2000, Windows XP, Linux

Table 4-11-1 HTTPS System Support

- To specify a secure-site certificate, see "**Replacing the Default Secure-site Certificate**".

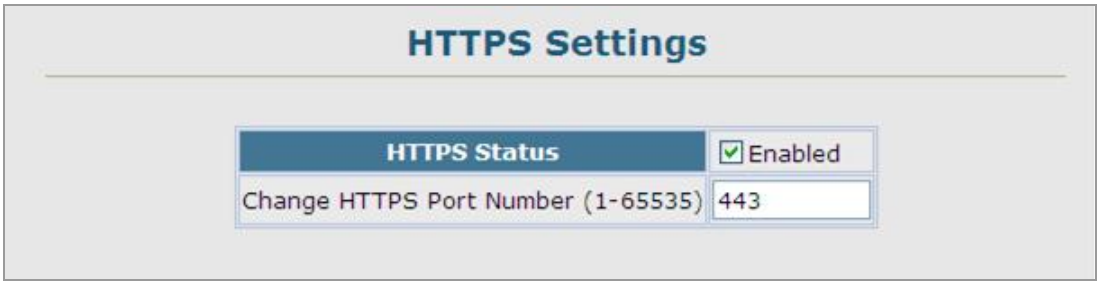


Figure 4-11-15 Settings screenshot

1. Click Security, HTTPS Settings.
2. Enable HTTPS and specify the port number, then click Apply.

The page includes the following fields:

Object	Description
HTTPS Status	Allows you to enable/disable the HTTPS server feature on the switch. (Default: **Enabled**)
Change HTTPS Port Number	Specifies the UDP port number used for HTTPS/ SSL connection to the switch's web interface. (Default: Port **443**)

Replacing the Default Secure-site Certificate

When you log onto the web interface using HTTPS (for secure access), a Secure Sockets Layer (SSL) certificate appears for the switch. By default, the certificate that Netscape and Internet Explorer display will be associated with a warning that the site is not recognized as a secure site. This is because the certificate has not been signed by an approved certification authority. If you want this warning to be replaced by a message confirming that the connection to the switch is secure, you must obtain a unique certificate and a private key and password from a recognized certification authority.

For maximum security, we recommend you obtain a unique Secure Sockets Layer certificate at the earliest opportunity. This is because the default certificate for the switch is not unique to the hardware you have purchased.

When you have obtained these, place them on your TFTP server, and use the following command at the switch's command-line interface to replace the default (unrecognized) certificate with an authorized one:

The Managed witch must be reset for the new certificate to be activated.
To reset the Managed switch, type:
Console# reload

4.11.7 SSH

4.11.7.1 Configure Secure Shell

The Berkley-standard includes remote access tools originally designed for Unix systems. Some of these tools have also been implemented for Microsoft Windows and other environments. These tools, including commands such as rlogin (remote login), rsh (remote shell), and rcp (remote copy), are not secure from hostile attacks.

The Secure Shell (SSH) includes server/client applications intended as a secure replacement for the older Berkley remote access tools. SSH can also provide remote management access to this switch as a secure replacement for Telnet. When the client contacts the switch via the SSH protocol, the switch generates a public-key that the client uses along with a local user name and password for access authentication. SSH also encrypts all data transfers passing between the switch and SSH-enabled management station clients, and ensures that data traveling over the network arrives unaltered.

1. You need to install an SSH client on the management station to access the Managed Switch for management via the SSH protocol.
2. The Managed Switch supports both SSH Version 1.5 and 2.0.

Command Usage

The SSH server on this switch supports both password and public key authentication. If password authentication is specified by the SSH client, then the password can be authenticated either locally or via a RADIUS or TACACS+ remote authentication server, as specified on the **Authentication Settings** page. If public key authentication is specified by the client, then you must configure authentication keys on both the client and the switch as described in the following section. Note that regardless of whether you use public key or password authentication, you still have to generate authentication keys on the switch (SSH Host Key Settings) and enable the SSH server (**Authentication Settings**).

To use the SSH server, complete these steps:

1. **Generate a Host Key Pair** – On the SSH Host Key Settings page, create a host public/private key pair.
2. **Provide Host Public Key to Clients** – Many SSH client programs automatically import the host public key during the initial connection setup with the switch. Otherwise, you need to manually create a known hosts file on the management station and place the host public key in it. An entry for a public key in the known hosts file would appear similar to the following example:

10.1.0.54 1024 35 156849954018676692593339467750546173253136748908365472541502024559319986854435836165199992332978176606583095610825913212890233765468017262725714134287629413011961955667825954166410486957427888146206519417467729848654686157177393901647793559423035774130980227370877945452408397175264635805817671670957480477611 7

3. Import Client's Public Key to the Switch – Use the **copy tftp public-key** command to copy a file containing the public key for all the SSH client's granted management access to the switch. (Note that these clients must be configured locally on the switch via the User Accounts page as described.) The clients are subsequently authenticated using these keys. The current firmware only accepts public key files based on standard UNIX format as shown in the following example for an RSA Version 1 key:

   1024 35 134108168560989392104094492015542534763164192187295892114317388 0
   055536161631051775940838686311092912322268285192543746031009371877211996
   963178136627741416898513204911720483033925432410163799759237144901193800
   609025394840848271781943722884025331159521348610229029789827213532671316
   29432532818915045306393916643 steve@192.168.1.19

4. **Set the Optional Parameters** – On the SSH Settings page, configure the optional parameters, including the authentication timeout, the number of retries, and the server key size.
5. **Enable SSH Service** – On the SSH Settings page, enable the SSH server on the switch.
6. **Authentication** – One of the following authentication methods is employed: Password Authentication (for SSH v1.5 or V2 Clients)
   a. The client sends its password to the server.
   b. The Managed Switch compares the client's password to those stored in memory.
   c. If a match is found, the connection is allowed.

To use SSH with only password authentication, the host public key must still be given to the client, either during initial connection or manually entered into the known host file. However, you do not need to configure the client's keys.

7. **Public Key Authentication** – When an SSH client attempts to contact the switch, the SSH server uses the host key pair to negotiate a session key and encryption method. Only clients that have a private key corresponding to the public keys stored on the switch can access it. The following exchanges take place during this process:

   Authenticating SSH v1.5 Clients

   a. The client sends its RSA public key to the switch.
   b. The switch compares the client's public key to those stored in memory.
   c. If a match is found, the switch uses its secret key to generate a random 256-bit string as a challenge, encrypts this string with the user's public key, and sends it to the client.
   d. The client uses its private key to decrypt the challenge string, computes the MD5 checksum, and sends the checksum back to the switch.
   e. The switch compares the checksum sent from the client against that computed for the original string it sent. If the two checksums match, this means that the client's private key corresponds to an authorized public key, and the client is authenticated.

   Authenticating SSH v2 Clients

   a. The client first queries the switch to determine if DSA public key authentication using a preferred algorithm is

acceptable.

b. If the specified algorithm is supported by the switch, it notifies the client to proceed with the authentication process. Otherwise, it rejects the request.

c. The client sends a signature generated using the private key to the switch.

d. When the server receives this message, it checks whether the supplied key is acceptable for authentication, and if so, it then checks whether the signature is correct. If both checks succeed, the client is authenticated.

Note

The SSH server supports up to four client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

4.11.7.2 SSH Server Settings

The SSH server includes basic settings for authentication.

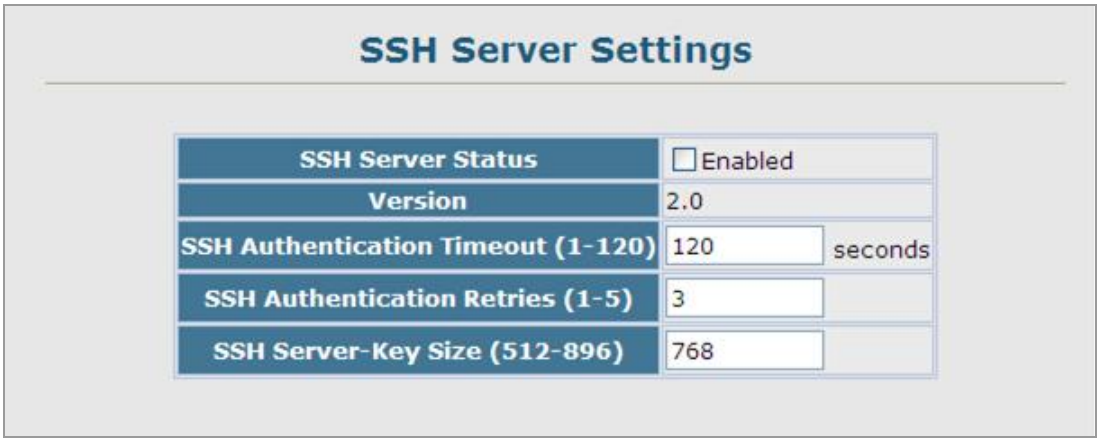


Figure 4-11-16 Settings screenshot

Click Security, SSH, Settings. Enable SSH and adjust the authentication parameters as required, then click Apply. Note that you must first generate the host key pair on the SSH Host-Key Settings page before you can enable the SSH server.

The page includes the following fields:

Object	Description
SSH Server Status	Allows you to enable/disable the SSH server on the switch. (Default: **Disabled**)
Version	The Secure Shell version number. Version 2.0 is displayed, but the switch supports management access via either SSH Version 1.5 or 2.0 clients.
SSH Authentication Timeout	Specifies the time interval in seconds that the SSH server waits for a response from a client during an authentication attempt.

	(Range: 1-120 seconds; Default: **120** seconds)
SSH Authentication Retries	Specifies the number of authentication attempts that a client is allowed before authentication fails and the client has to restart the authentication process. (Range: 1-5 times; Default: **3**)
SSH Server-Key Size	Specifies the SSH server key size. (Range: 512-896 bits; Default:**768**) -The server key is a private key that is never shared outside the switch. -The host key is shared with the SSH client, and is fixed at 1024 bits.

4.11.7.3 SSH Host-Key Settings

A host public/private key pair is used to provide secure communications between an SSH client and the switch. After generating this key pair, you must provide the host public key to SSH clients and import the client's public key to the switch as described in the proceeding section (Command Usage).

Figure 4-11-17 Settings screenshot

1. Click Security, SSH, Host-Key Settings.
2. Select the host-key type from the drop-down box, select the option to save the host key from memory to flash (if required) prior to generating the key, and then click Generate.

The page includes the following fields:

Object	Description
Public-Key of Host-Key	The public key for the host. **-RSA** (Version 1): The first field indicates the size of the host key (e.g., 1024), the second field is the encoded public exponent (e.g., 65537), and the last string is the encoded modulus. **-DSA** (Version 2): The first field indicates that the encryption method used by SSH is based on the Digital Signature Standard (DSS). The last string is the encoded modulus.
Host-Key Type	The key type used to generate the host key pair (i.e., public and private keys) ■ .**Range: RSA (Version 1)** ■ **DSA (Version 2)** ■ **Both** Default: RSA The SSH server uses RSA or DSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either **DES (56-bit)** or **3DES (168-bit)** for data encryption.
Save Host-Key from Memory to Flash	Saves the host key from RAM (i.e., volatile memory to flash memory. Otherwise, the host key pair is stored to RAM by default. Note that you must select this item prior to generating the host-key pair.
Generate	This button is used to generate the host key pair. Note that you must first generate the host key pair before you can enable the SSH server on the SSH Server Settings page.
Clear	This button clears the host key from both volatile memory (RAM) and non-volatile memory (Flash).

Note

The Managed Switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 for SSHv2 clients.

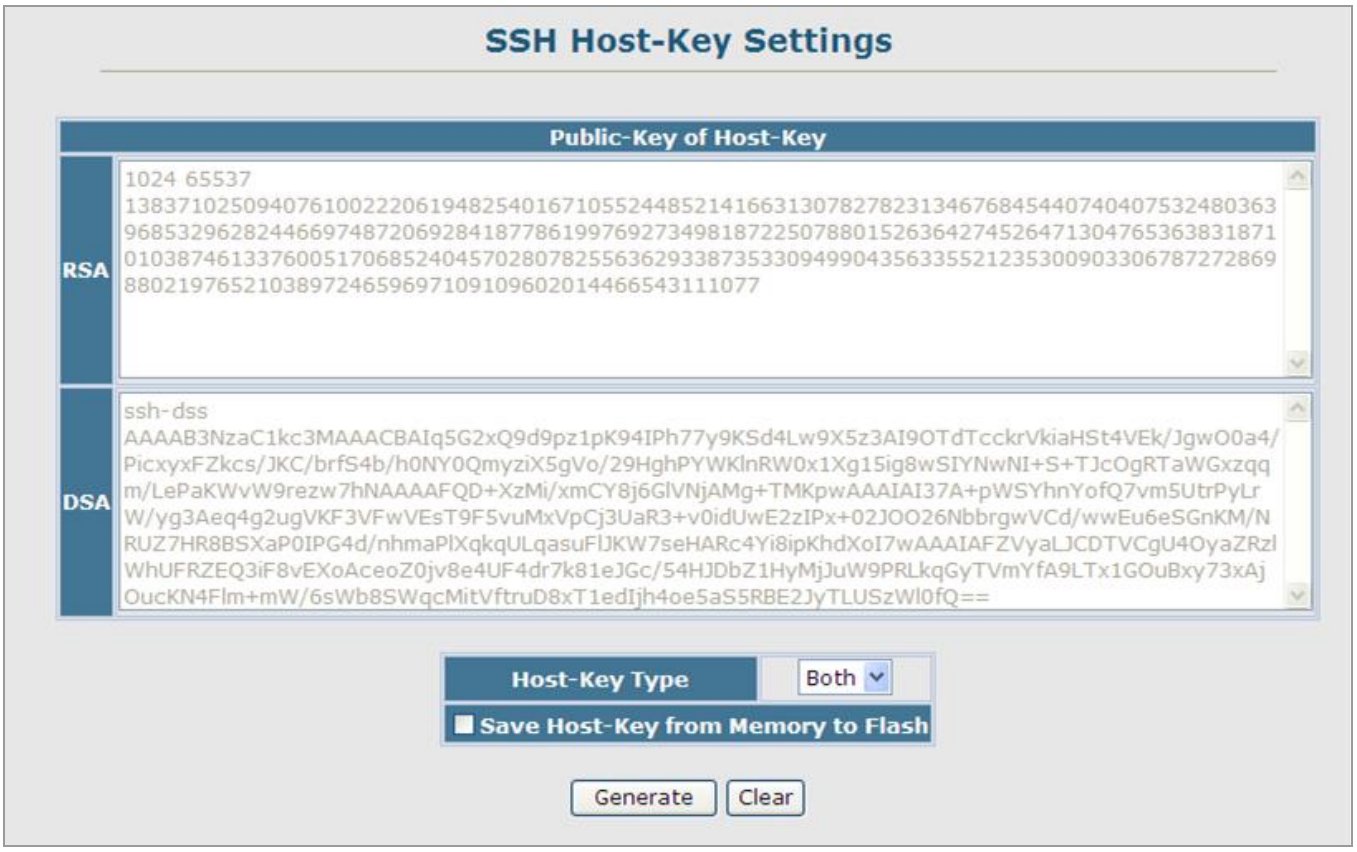


Figure 4-11-18 Settings screenshot

4.11.8 802.1X Port Authentication

Network switches can provide open and easy access to network resources by simply attaching a client PC. Although this automatic configuration and access is a desirable feature, it also allows unauthorized personnel to easily intrude and possibly gain access to sensitive network data.

The IEEE 802.1X (dot1X) standard defines a port-based access control procedure that prevents unauthorized access to a network by requiring users to first submit credentials for authentication. Access to all switch ports in a network can be centrally controlled from a server, which means that authorized users can use the same credentials for authentication from any point within the network.

This Managed Switch uses the Extensible Authentication Protocol over LANs (EAPOL) to exchange authentication protocol messages with the client, and a remote RADIUS authentication server to verify user identity and access rights. When a client (i.e., Supplicant) connects to a switch port, the switch (i.e., Authenticator) responds with an EAPOL identity request. The client provides its identity (such as a user name) in an EAPOL response to the switch, which it forwards to the RADIUS server. The RADIUS server verifies the client identity and sends an access challenge back to the client. The EAP packet from the RADIUS server contains not only the challenge, but the authentication method to be used. The client can reject the authentication method and request another, depending on the configuration of the client software and the RADIUS server. The encryption method used to pass authentication messages can be MD5 (Message-Digest 5), TLS (Transport Layer Security), PEAP (Protected Extensible Authentication Protocol), or TTLS (Tunneled Transport Layer Security). The client responds to the appropriate method with its credentials, such as a password or certificate. The RADIUS server verifies the client credentials and responds with an accept or reject packet. If authentication is successful, the switch allows the client to access the network. Otherwise, non-EAP traffic on the port is blocked or assigned to a guest VLAN based on the "intrusion-action" setting. In "multi-host" mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.

The operation of 802.1X on the switch requires the following:

- The switch must have an IP address assigned.
- **RADIUS authentication** must be enabled on the switch and the IP address of the **RADIUS server specified**.
- 802.1X must be enabled globally for the switch.
- Each switch port that will be used must be set to **dot1X "Auto"** mode.
- Each client that needs to be authenticated must have **dot1X client software** installed and properly configured.
- The RADIUS server and 802.1X client support EAP. (The switch only supports EAPOL in order to pass the EAP packets from the server to the client.)
- The RADIUS server and client also have to support the same EAP authentication type – MD5, PEAP, TLS, or TTLS. (Some clients have native support in the operating system, otherwise the dot1x client must support the required authentication method.)

4.11.8.1 Understanding IEEE 802.1X Port-Based Authentication

The IEEE 802.1X standard defines a client-server-based access control and authentication protocol that restricts unauthorized clients from connecting to a LAN through publicly accessible ports. The authentication server authenticates each client connected to a switch port before making available any services offered by the switch or the LAN.

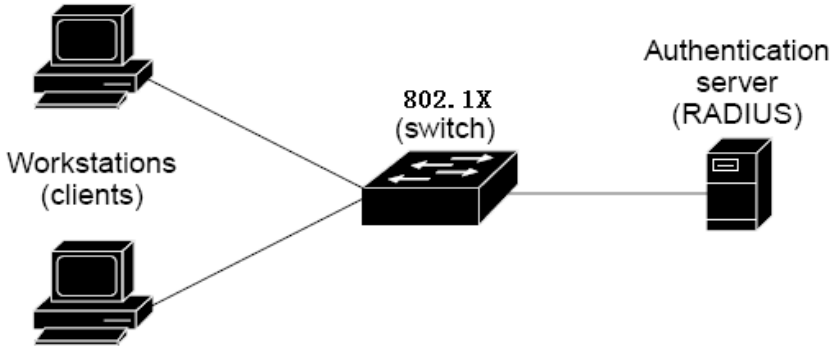
Until the client is authenticated, 802.1X access control allows only Extensible Authentication Protocol over LAN (EAPOL) traffic through the port to which the client is connected. After authentication is successful, normal traffic can pass through the port.

This section includes this conceptual information:

- Device Roles
- Authentication Initiation and Message Exchange
- Ports in Authorized and Unauthorized States

■ **Device Roles**

With 802.1X port-based authentication, the devices in the network have specific roles as shown below.



- ***Client***—the device (workstation) that requests access to the LAN and switch services and responds to requests from the switch. The workstation must be running 802.1X-compliant client software such as that offered in the Microsoft Windows XP operating system. (The client is the *supplicant* in the IEEE 802.1X specification.)

- ***Authentication server***—performs the actual authentication of the client. The authentication server validates the identity of the client and notifies the switch whether or not the client is authorized to access the LAN and switch services. Because the switch acts as the proxy, the authentication service is transparent to the client. In this release, the Remote Authentication Dial-In User Service (RADIUS) security system with Extensible Authentication Protocol (EAP) extensions is the only supported authentication server; it is available in Cisco Secure Access Control Server version 3.0. RADIUS operates in a client/server model in which secure authentication information is exchanged between the RADIUS server and one or more RADIUS clients.

- ***Switch* (802.1X device)**—controls the physical access to the network based on the authentication status of the client. The switch acts as an intermediary (proxy) between the client and the authentication server, requesting identity

information from the client, verifying that information with the authentication server, and relaying a response to the client. The switch includes the RADIUS client, which is responsible for encapsulating and decapsulating the Extensible Authentication Protocol (EAP) frames and interacting with the authentication server. When the switch receives EAPOL frames and relays them to the authentication server, the Ethernet header is stripped and the remaining EAP frame is re-encapsulated in the RADIUS format. The EAP frames are not modified or examined during encapsulation, and the authentication server must support EAP within the native frame format. When the switch receives frames from the authentication server, the server's frame header is removed, leaving the EAP frame, which is then encapsulated for Ethernet and sent to the client.

- **Authentication Initiation and Message Exchange**

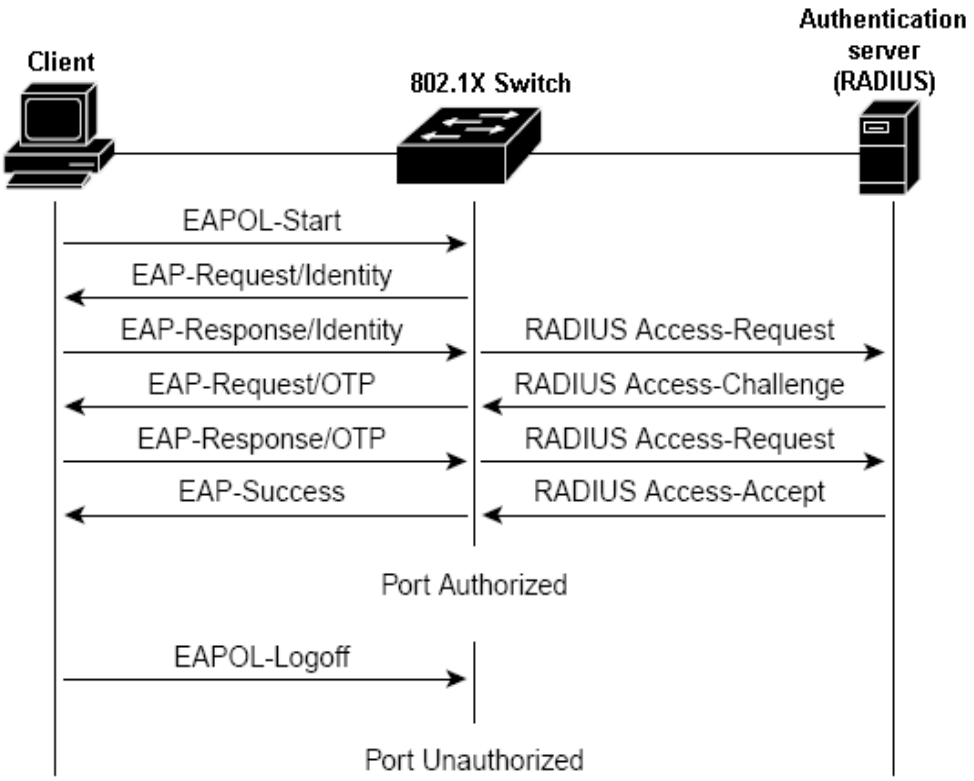
The switch or the client can initiate authentication. If you enable authentication on a port by using the **dot1x port-control auto** interface configuration command, the switch must initiate authentication when it determines that the port link state transitions from down to up. It then sends an EAP-request/identity frame to the client to request its identity (typically, the switch sends an initial identity/request frame followed by one or more requests for authentication information). Upon receipt of the frame, the client responds with an EAP-response/identity frame.

However, if during bootup, the client does not receive an EAP-request/identity frame from the switch, the client can initiate authentication by sending an EAPOL-start frame, which prompts the switch to request the client's identity

If 802.1X is not enabled or supported on the network access device, any EAPOL frames from the client are dropped. If the client does not receive an EAP-request/identity frame after three attempts to start authentication, the client transmits frames as if the port is in the authorized state. A port in the authorized state effectively means that the client has been successfully authenticated.

When the client supplies its identity, the switch begins its role as the intermediary, passing EAP frames between the client and the authentication server until authentication succeeds or fails. If the authentication succeeds, the switch port becomes authorized.

The specific exchange of EAP frames depends on the authentication method being used. "Figure 2-43" shows a message exchange initiated by the client using the One-Time-Password (OTP) authentication method with a RADIUS server.



- **Ports in Authorized and Unauthorized States**

The switch port state determines whether or not the client is granted access to the network. The port starts in the *unauthorized* state. While in this state, the port disallows all ingress and egress traffic except for 802.1X protocol packets. When a client is successfully authenticated, the port transitions to the *authorized* state, allowing all traffic for the client to flow normally.

If a client that does not support 802.1X is connected to an unauthorized 802.1X port, the switch requests the client's identity. In this situation, the client does not respond to the request, the port remains in the unauthorized state, and the client is not granted access to the network.

In contrast, when an 802.1X-enabled client connects to a port that is not running the 802.1X protocol, the client initiates the authentication process by sending the EAPOL-start frame. When no response is received, the client sends the request for a fixed number of times. Because no response is received, the client begins sending frames as if the port is in the authorized state

If the client is successfully authenticated (receives an Accept frame from the authentication server), the port state changes to authorized, and all frames from the authenticated client are allowed through the port. If the authentication fails, the port remains in the unauthorized state, but authentication can be retried. If the authentication server cannot be reached, the switch can retransmit the request. If no response is received from the server after the specified number of attempts, authentication fails, and network access is not granted.
When a client logs off, it sends an EAPOL-logoff message, causing the switch port to transition to the unauthorized state.

If the link state of a port transitions from up to down, or if an EAPOL-logoff frame is received, the port returns to the unauthorized

state.

4.11.8.2 Displaying 802.1X Information

The 802.1X protocol provides client authentication.

Figure 4-11-19 Settings screenshot

The page includes the following fields:

Object	Description
802.1X System Authentication Control	The global settings for 802.1X.

4.11.8.3 802.1X Configuration

The 802.1X protocol provides port authentication. The 802.1X protocol must be enabled globally for the switch system before port settings are active.

Figure 4-11-20 Settings screenshot

1. Select Security, 802.1X, Configuration.
2. Enable 802.1X globally for the switch, and click Apply.

The page includes the following fields:

Object	Description
802.1X System Authentication Control	Sets the global setting for 802.1X. (Default: Disabled)

4.11.8.4 802.1X Port Configuration

When 802.1X is enabled, you need to configure the parameters for the authentication process that runs between the client and the switch (i.e., authenticator), as well as the client identity lookup process that runs between the switch and authentication server. These parameters are described in this section.

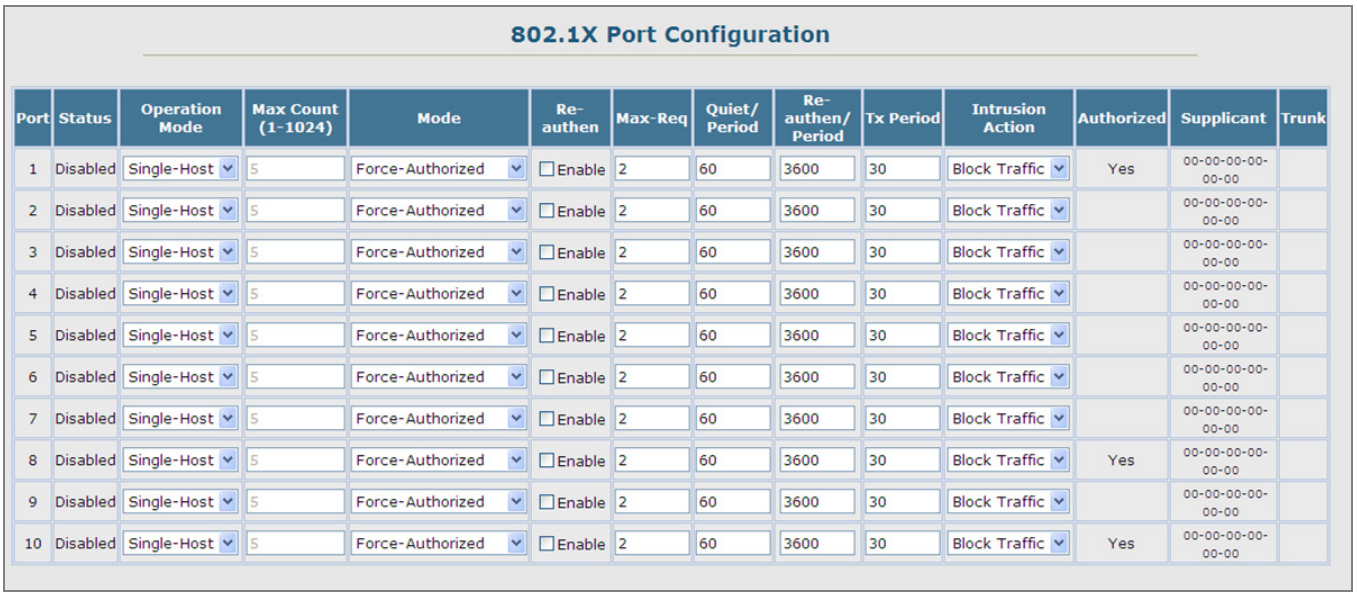

802.1X Port Configuration
Port Status Operation Mode Max Count (1-1024) Mode Re-authen Max-Req Quiet/ Period Re-authen/ Period Tx Period Intrusion Action Authorized Supplicant Trunk
1 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic Yes 00-00-00-00-00-00
2 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
3 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
4 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
5 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
6 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
7 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
8 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic Yes 00-00-00-00-00-00
9 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic 00-00-00-00-00-00
10 Disabled Single-Host 5 Force-Authorized Enable 2 60 3600 30 Block Traffic Yes 00-00-00-00-00-00

Figure 4-11-21 Settings screenshot

The page includes the following fields:

Object	Description
Port	Port number.
Status	Indicates if authentication is enabled or disabled on the port. (Default: Disabled)
Operation Mode	Allows single or multiple hosts (clients) to connect to an 802.1X-authorized port. Options: ■ **Single-Host** ■ **Multi-Host** Default: **Single-Host**
Max Count	The maximum number of hosts that can connect to a port when the Multi-Host operation mode is selected. Range: 1-1024;

	Default: **5**
Mode	Sets the authentication mode to one of the following options: **-Auto** Requires a dot1x-aware client to be authorized by the authentication server. Clients that are not dot1x-aware will be denied access. **-Force-Authorized** Forces the port to grant access to all clients, either dot1x-aware or otherwise. (This is the default setting.) **-Force-Unauthorized** Forces the port to deny access to all clients, either dot1x-aware or otherwise.
Re-authentication	Sets the client to be re-authenticated after the interval specified by the Re-authentication Period. Re-authentication can be used to detect if a new device is plugged into a switch port. (Default: **Disabled**)
Max-Request	Sets the maximum number of times the switch port will retransmit an EAP request packet to the client before it times out the authentication session. (Range: 1-10; Default **2**)
Quiet Period	Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client. Range: 1-65535 seconds Default: **60** seconds
Re-authentication Period	Sets the time period after which a connected client must be re-authenticated. Range: 1-65535 seconds Default: **3600** seconds
Tx Period	Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet. Range: 1-65535; Default: **30** seconds
Intrusion Action	Sets the port's response to a failed authentication. **-Block Traffic** Blocks all non-EAP traffic on the port. (This is the default setting.) **-Guest VLAN** All traffic for the port is assigned to a guest VLAN. The guest VLAN must be separately configured (See "**Creating VLANs**") and mapped on each port (See "**Configuring MAC Authentication for Ports**").
Authorized	Displays the 802.1X authorization status of connected clients. **-Yes** Connected client is authorized. **-No** Connected client is not authorized. **-Blank** Displays nothing when dot1x is disabled on a port.
Supplicant	Indicates the MAC address of a connected client.

Trunk	Indicates if the port is configured as a trunk port.

4.11.8.5 Displaying 802.1X Statistics

This Managed Switch can display statistics for dot1x protocol exchanges for any port.

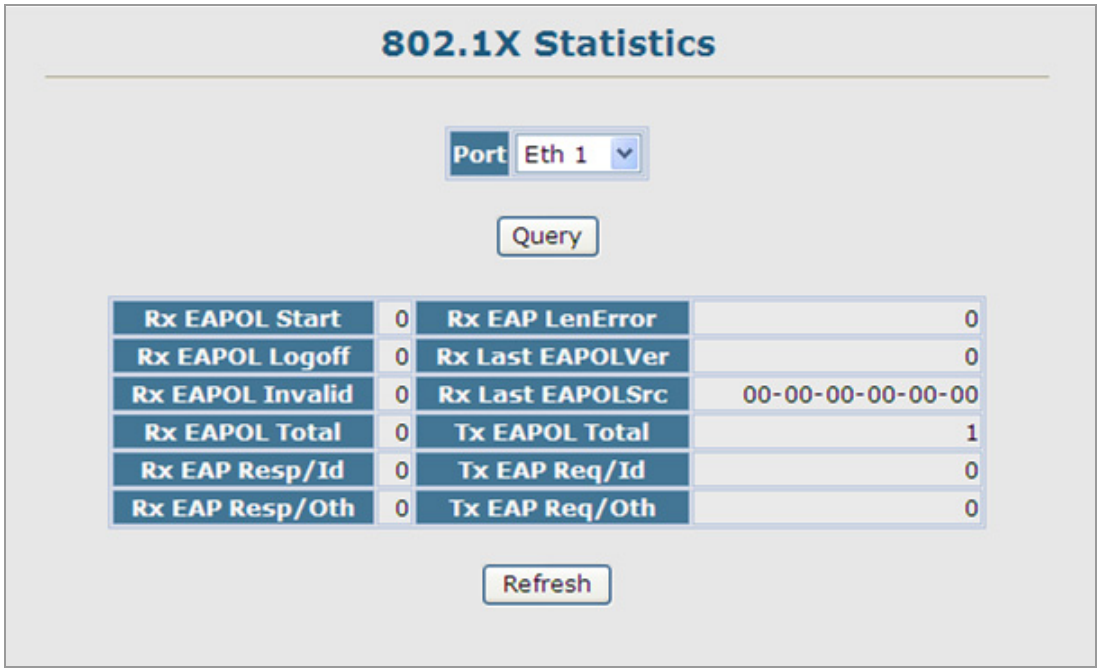


Figure 4-11-22 Settings screenshot

1. Select Security, 802.1X, Statistics.
2. Select the required port and then click Query.
3. Click Refresh to update the statistics.

The page includes the following fields:

Object	Description
Rx EAPOL Start	The number of EAPOL Start frames that have been received by this Authenticator.
Rx EAPOL Logoff	The number of EAPOL Logoff frames that have been received by this Authenticator.
Rx EAPOL Invalid	The number of EAPOL frames that have been received by this Authenticator in which the frame type is not recognized.
Rx EAPOL Total	The number of valid EAPOL frames of any type that have been received by this

	Authenticator.
Rx EAP Resp/Id	The number of EAP Resp/Id frames that have been received by this Authenticator.
Rx EAP Resp/Oth	The number of valid EAP Response frames (other than Resp/Id frames) that have been received by this Authenticator.
Rx EAP LenError	The number of EAPOL frames that have been received by this Authenticator in which the Packet Body Length field is invalid.
Rx Last EAPOLVer	The protocol version number carried in the most recently received EAPOL frame.
Rx Last EAPOLSrc	The source MAC address carried in the most recently received EAPOL frame.
Tx EAPOL Total	The number of EAPOL frames of any type that have been transmitted by this Authenticator.
Tx EAP Req/Id	The number of EAP Req/Id frames that have been transmitted by this Authenticator.
Tx EAP Req/Oth	The number of EAP Request frames (other than Rq/Id frames) that have been transmitted by this Authenticator.

4.11.8.6 Windows Platform RADIUS Server Configuration

1. Setup the RADIUS server and assign the client IP address to the switch. In this case, field in the default IP Address of the switch with 192.168.0.100. And also make sure the shared secret key is as same as the one you had set at the switch RADIUS server – **12345678** at this case.

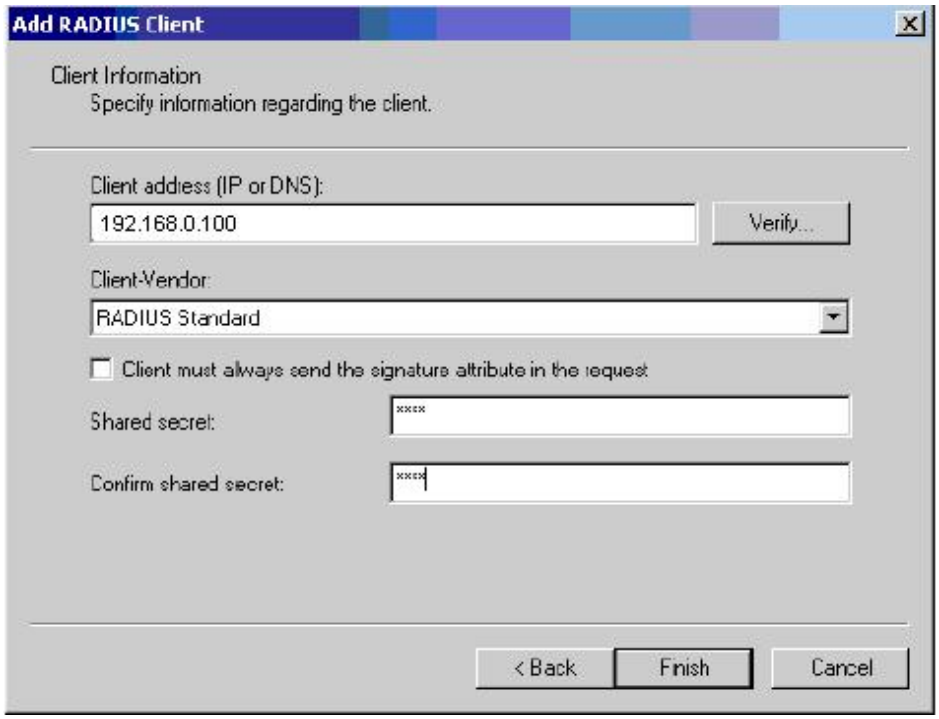


Figure 4-11-23 Windows Server RADIUS Server setting

2. Configure ports attribute of 802.1X, the same as "802.1X Port Configuration".

802.1X Port Configuration

Port	Status	Operation Mode	Max Count (1-1024)	Mode	Re-authen	Max-Req	Quiet/ Period	Re-authen/ Period	Tx Period	Intrusion Action	Authorized	Supplicant	Trunk
1	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic	Yes	00-00-00-00-00-00	
2	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
3	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
4	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
5	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
6	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
7	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
8	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic	Yes	00-00-00-00-00-00	
9	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic		00-00-00-00-00-00	
10	Disabled	Single-Host	5	Force-Authorized	Enable	2	60	3600	30	Block Traffic	Yes	00-00-00-00-00-00	

Figure 4-11-24 802.1x Port Configuration

3. Create user data. That step are different of "Local Authenticate", the establishment of the user data needs to be created on the Radius Server PC. For example, the Radius Server founded on Win2000 Server, and then:

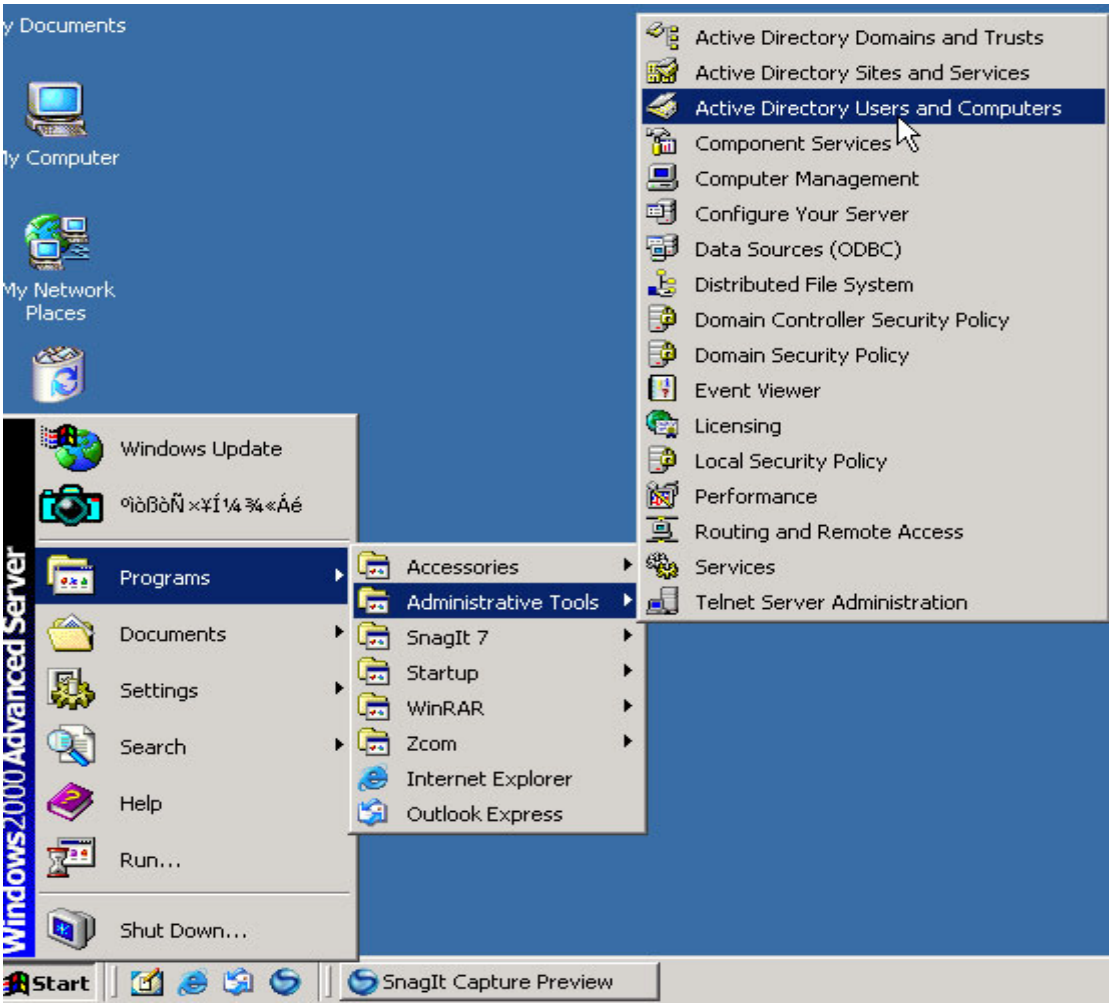


Figure 4-11-25 Windows Server RADIUS Server setting path

4. Enter " **Active Directory Users and Computers**", create legal user data, the next, right-click a user what you created to enter properties, and what to be noticed:

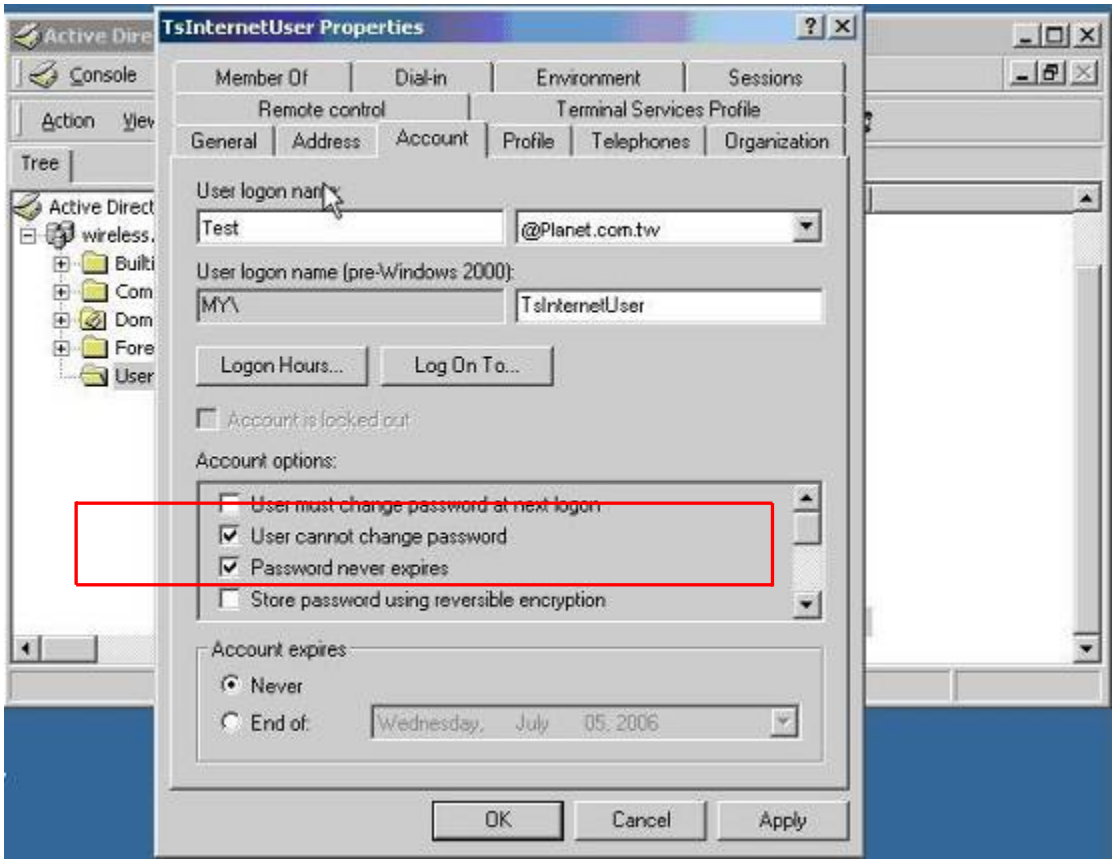


Figure 4-11-26 TsInternetUser Properties screen

Note

Set the Ports Authenticate Status to "**Force Authorized**" if the port is connected to the RADIUS server or the port is a uplink port that is connected to another switch. Or once the 802.1X stat to work, the switch might not be able to access the RADIUS server.

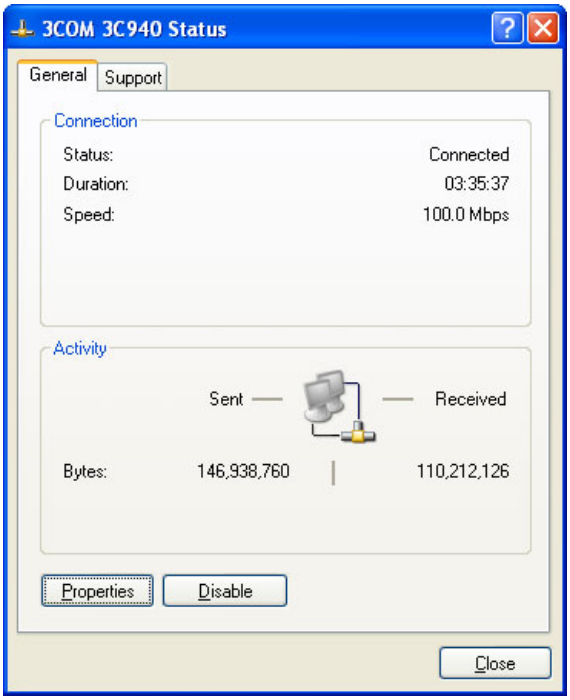
4.11.8.7 802.1X Client Configuration

Windows XP is originally 802.1X support. As to other operating systems (windows 98SE, ME, 2000), an 802.1X client utility is needed. The following procedures show how to configure 802.1X Authentication in Windows XP.
Please note that if you want to change the 802.1x authentication type of a wireless client, i.e. switch to EAP-TLS from EAP-MD5, you must remove the current existing wireless network from your preferred connection first, and add it in again.

■ Configure Sample: EAP-MD5 Authentication

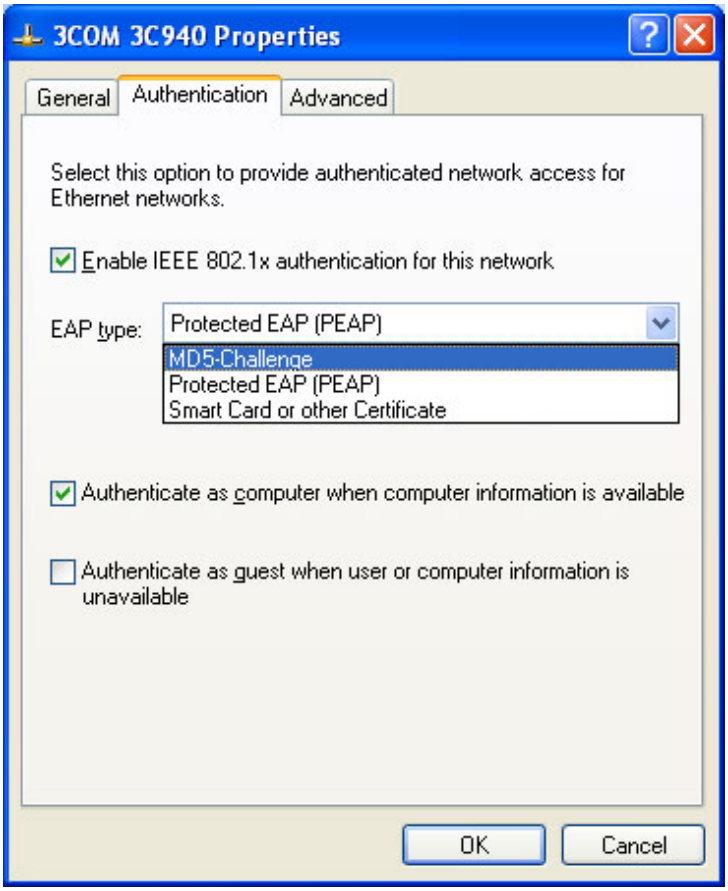
1. Go to **Start** > **Control Panel,** double-click on "**Network Connections**".
2. Right-click on the Local Network Connection.

3. Click "**Properties**" to open up the Properties setting window.



4. Select "**Authentication**" tab.

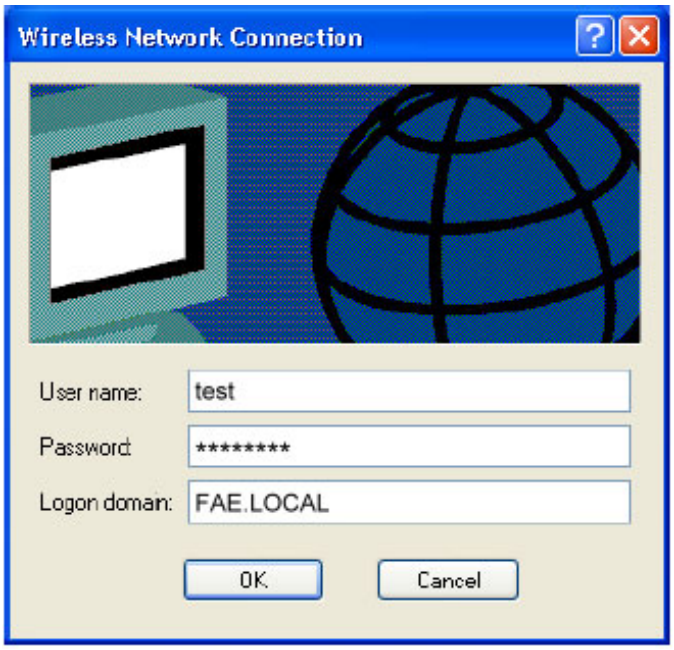
5. Select "**Enable network access control using IEEE 802.1X**" to enable 802.1x authentication.



6. Select "**MD-5 Challenge**" from the drop-down list box for EAP type.

7. Click "**OK**".
8. When client has associated with the Managed Switch, a user authentication notice appears in system tray. Click on the notice to continue.

9. Enter the user name, password and the logon domain that your account belongs.
10. Click "**OK**" to complete the validation process.



4.11.9 Client Security

This Managed Switch supports many methods of segregating traffic for clients attached to each of the data ports, and for ensuring that only authorized clients gain access to the network. Private VLANs and port-based authentication using IEEE 802.1X are commonly used for these purposes. In addition to these methods, several other options of providing client security are supported by this switch. These include port-based authentication, which can be configured for network client access by specifying a fixed set of MAC addresses. The addresses assigned to DHCP clients can also be carefully controlled using static or dynamic bindings with the IP Source Guard and DHCP Snooping commands.

This Managed Switch provides client security using the following options:

- **Private VLANs** – Provide port-based security and isolation between ports within the assigned VLAN. (See "**Private VLANs**")
- **Port Security** – Configure secure addresses for individual ports.
- **802.1X** – Use IEEE 802.1X port authentication to control access to specific ports. (See "**Configuring 802.1X Port Authentication**".)
- **Web Authentication** - Allows stations to authenticate and access the network in situations where 802.1X or Network Access authentication methods are infeasible or impractical.
- **Network Access** - Configures MAC authentication and dynamic VLAN assignment.
- **ACL** -Access Control Lists provide packet filtering for IP frames (based on address, protocol, Layer 4 protocol port number or TCP control code) or any frames (based on MAC address or Ethernet type).
- **DHCP Snooping** – Filters IP traffic on unsecure ports for which the source address cannot be identified via DHCP snooping nor static source bindings. (See "**DHCP Snooping**".)
- **IP Source Guard** – Filters untrusted DHCP messages on unsecure ports by building and maintaining a DHCP snooping binding table. (See "**IP Source Guard**".)

The priority of execution for the filtering commands is Port Security, Port Authentication, Network Access, Web Authentication, Access Control Lists, IP Source Guard, and then DHCP Snooping.

4.11.10 Port Security

Port security is a feature that allows you to configure a switch port with one or more device MAC addresses that are authorized to access the network through that port.

When port security is enabled on a port, the Managed Switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table will be authorized to access the network through that port. If a device with an unauthorized MAC address attempts to use the switch port, the intrusion will be detected and the switch can automatically take action by disabling the port and sending a trap message.

To use port security, specify a maximum number of addresses to allow on the port and then let the switch dynamically learn the <**source MAC address, VLAN**> pair for frames received on the port. Note that you can also manually add secure addresses to the port using the **Static Address Table**. When the port has reached the maximum number of MAC addresses the selected port will stop learning. The MAC addresses already in the address table will be retained and will not age out. Any other device that attempts to use the port will be prevented from accessing the switch.

Command Usage

- A secure port has the following restrictions:
  - It cannot be used as a member of a static or dynamic trunk.
  - It should not be connected to a network interconnection device.
- The default maximum number of MAC addresses allowed on a secure port is zero. You must configure a maximum address count from 1 - 1024 for the port to allow access.
- If a port is disabled (shut down) due to a security violation, it must be manually re-enabled from the Port/Port Configuration page.

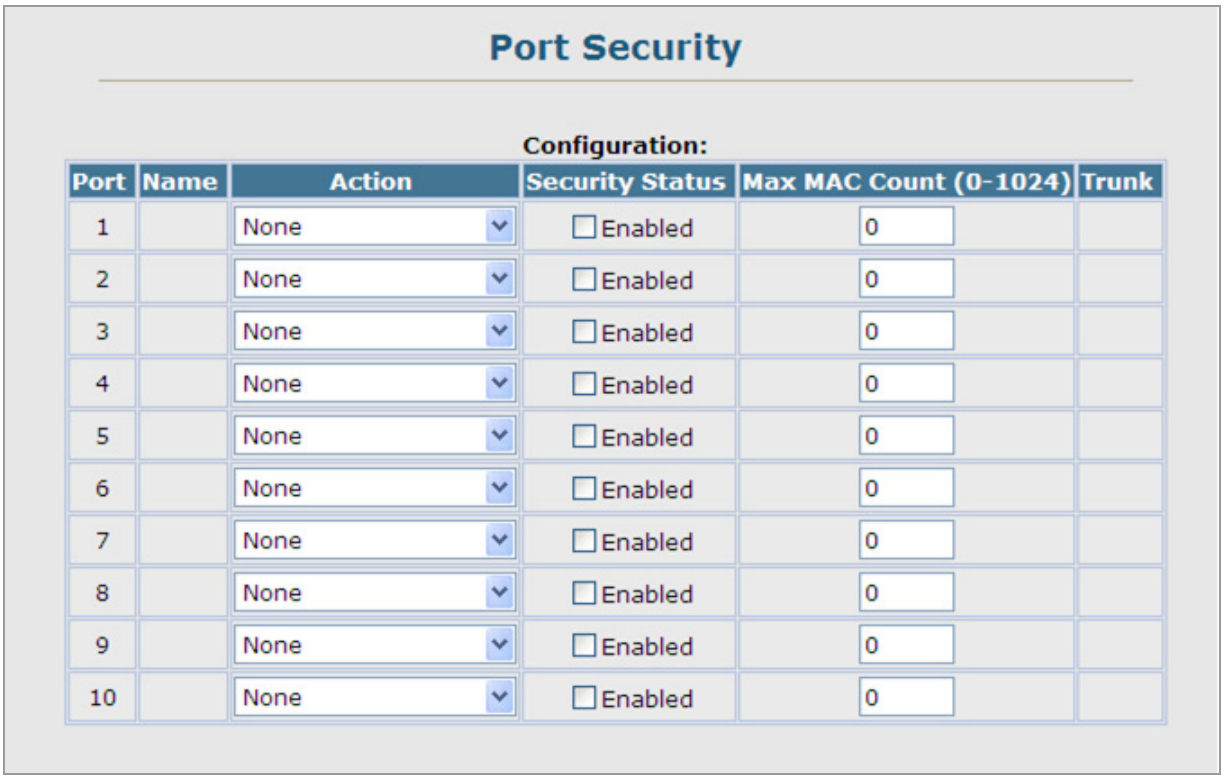


Figure 4-11-23 Settings screenshot

Click Security, Port Security. Set the action to take when an invalid address is detected on a port, mark the checkbox in the Status column to enable security for a port, set the maximum number of MAC addresses allowed on a port, and click Apply.

The page includes the following fields:

Object	Description
Port	Port number.
Name	Descriptive text
Action	Indicates the action to be taken when a port security violation is detected: **- None:** No action should be taken. **- Trap** Send an SNMP trap message. **- Shutdown:** Disable the port. **- Trap and Shutdown:** Send an SNMP trap message and disable the port. Default: **None**
Security Status	Enables or disables port security on the port. (Default: **Disabled**)
Max MAC Count	The maximum number of MAC addresses that can be learned on a port. (Range: 0 -1024, where 0 means disabled)

Trunk	Trunk number if port is a member

This example selects the target port, sets the port security action to send a trap and disable the port, sets the maximum MAC addresses allowed on the port, and then enables port security for the port.

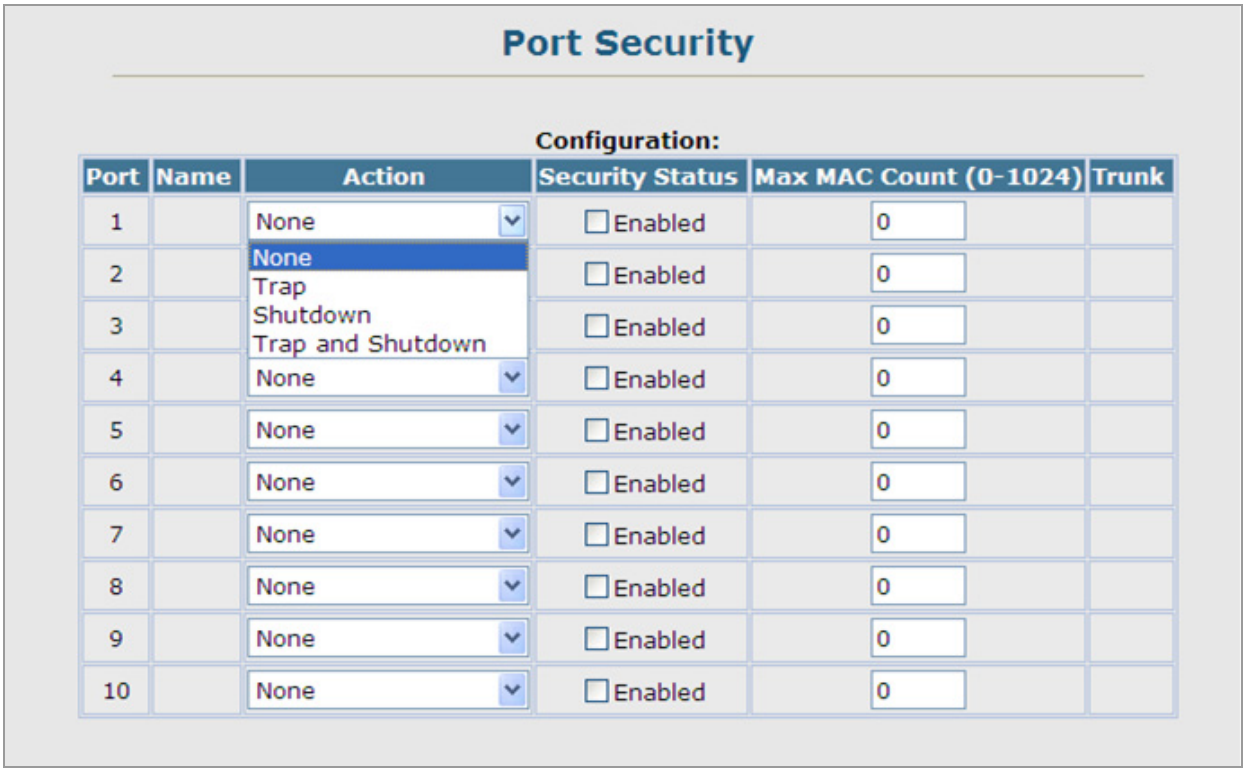


Figure 4-11-24 Settings screenshot

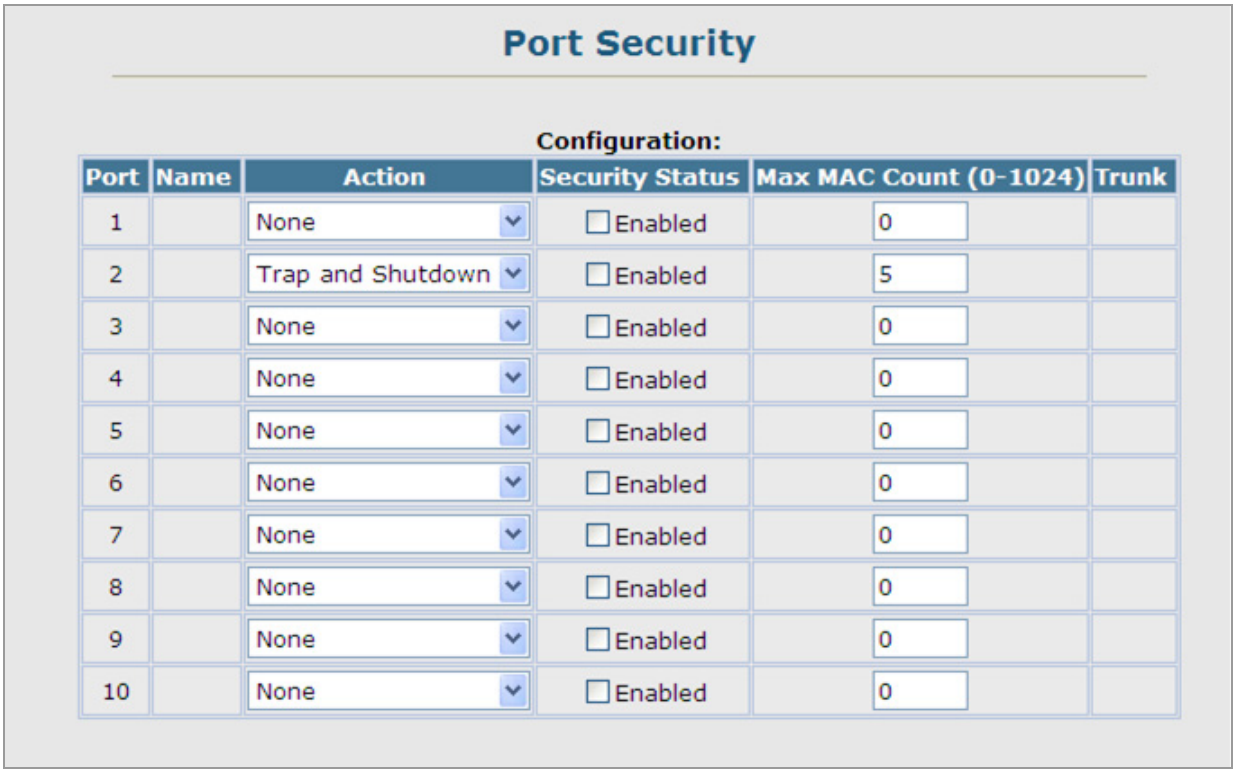

Port Security
Configuration:
Port Name Action Security Status Max MAC Count (0-1024) Trunk
1 None Enabled 0
2 Trap and Shutdown Enabled 5
3 None Enabled 0
4 None Enabled 0
5 None Enabled 0
6 None Enabled 0
7 None Enabled 0
8 None Enabled 0
9 None Enabled 0
10 None Enabled 0

Figure 4-11-25 Settings screenshot

4.11.11 Web Authentication

Web authentication allows stations to authenticate and access the network in situations where 802.1X or Network Access authentications are infeasible or impractical. The web authentication feature allows unauthenticated hosts to request and receive a DHCP assigned IP address and perform DNS queries. All other traffic, except for HTTP protocol traffic, is blocked. The switch intercepts HTTP protocol traffic and redirects it to a switch-generated web page that facilitates username and password authentication via RADIUS. Once authentication is successful, the web browser is forwarded on to the originally requested web page.

Note

1. RADIUS authentication must be activated and configured properly for the web authentication feature to work properly. (See "Configuring Local/Remote Logon Authentication" on page 3-58)
2. Web authentication cannot be configured on trunk ports.

4.11.11.1 Web Authentication Configuration

Web authentication is configured on a per-port basis, however there are four configurable parameters that apply globally to all ports on the Managed Switch.

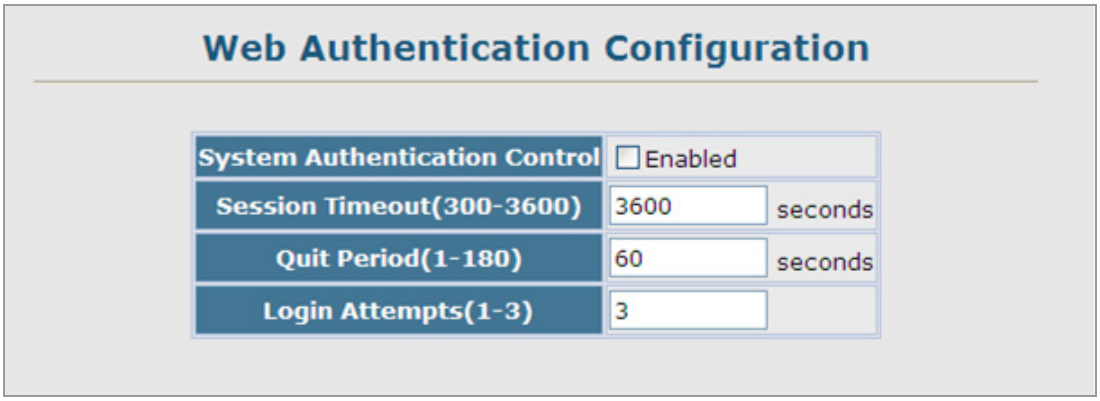


Figure 4-11-26 Settings screenshot

1. Click Security, Web Authentication, Configuration.
2. Set the required global parameters, and click Apply.

The page includes the following fields:

Object	Description
System Authentication Control	Enables Web Authentication for the switch. (Default: **Disabled**)
Session Timeout	Configures how long an authenticated session stays active before it must be re-authenticated. Range: 300-3600 seconds; Default: **3600** seconds
Quiet Period	Configures how long a host must wait to attempt authentication again after it has exceeded the maximum allowable failed login attempts. Range: 1-180 seconds; Default: **60** seconds
Login Attempts	Configures the number of times a supplicant may attempt and fail authentication before it must wait the configured quiet period. Range: 1-3 attempts; Default: **3** attempts

4.11.11.2 Web Authentication Port Configuration

Web authentication is configured on a per-port basis. The following parameters are associated with each port.

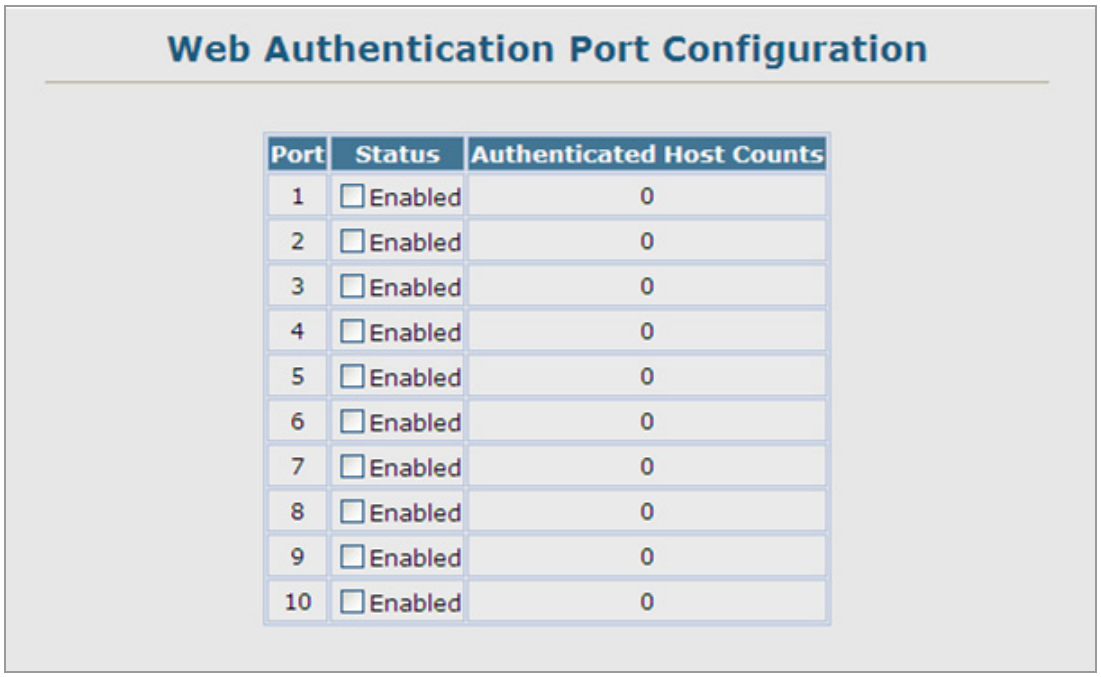


Figure 4-11-27 Settings screenshot

1. Click Security, Web Authentication, Port Configuration.
2. Set the status box to enabled for any port that requires web authentication, and click Apply.

The page includes the following fields:

Object	Description
Port	Indicates the port being configured
Status	Configures web authentication status for a port.
Authenticated Host Counts	Indicates how many authenticated hosts are connected to the port.

4.11.11.3 Web Authentication Port Information

This Managed Switch can display web authentication information for all ports and connected hosts.

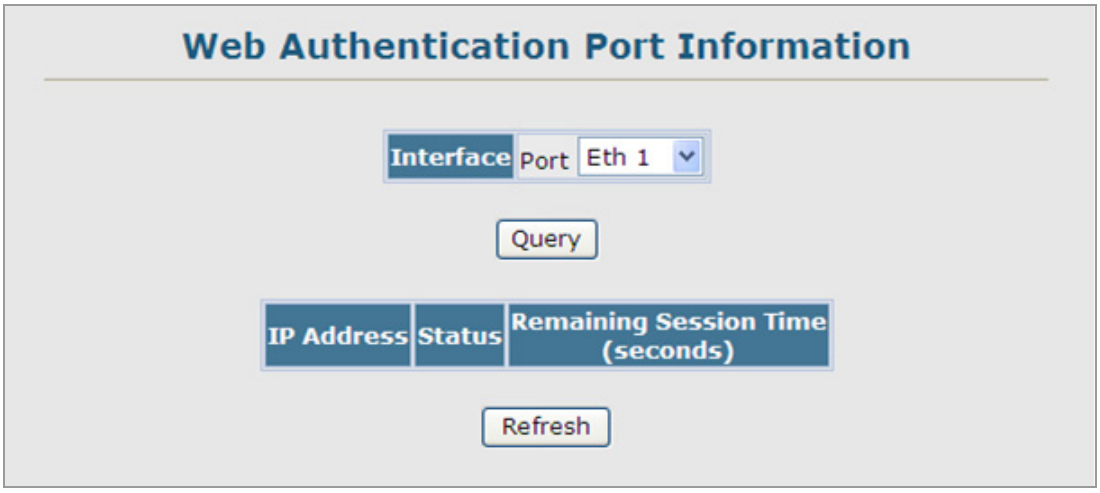


Figure 4-11-28 Settings screenshot

The page includes the following fields:

Object	Description
Interface	Indicates the port to query.
IP Address	Indicates the IP address of each connected host.
Status	Indicates the authorization status of each connected host.
Remaining Session Time (seconds)	Indicates the remaining time until the current authorization session for a host expires.

4.11.11.4 Re-Authentication

The Managed Switch allows an administrator to manually force re-authentication of any web-authenticated host connected to any port.

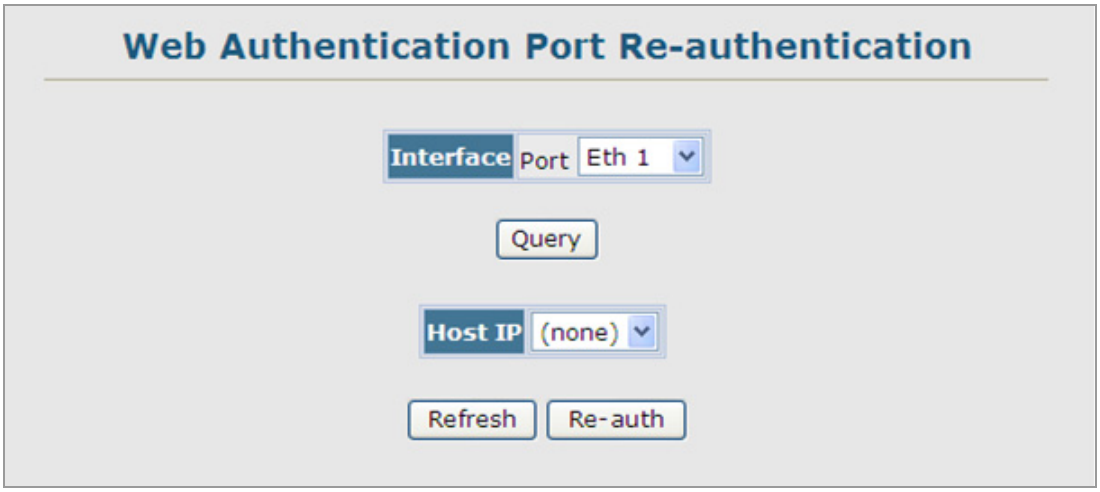


Figure 4-11-29 Settings screenshot

The page includes the following fields:

Object	Description
Interface	Indicates the port to query.
Host IP	Indicates the IP address of the host selected for re-authentication.

4.11.12 Network Access (MAC Address Authentication)

Some devices connected to switch ports may not be able to support 802.1X authentication due to hardware or software limitations. This is often true for devices such as network printers, IP phones, and some wireless access points. This switch enables network access from these devices to be controlled by authenticating device MAC addresses with a central RADIUS server.

1. RADIUS authentication must be activated and configured properly for the MAC Address authentication feature to work properly. (See "**RADIUS Client**".)
2. MAC authentication cannot be configured on trunk ports.

2. MAC authentication cannot be configured on trunk ports.

Command Usage

- Network Access authentication controls access to the network by authenticating the MAC address of each host that attempts to connect to a switch port. Traffic received from a specific MAC address is forwarded by the switch only if the source MAC address is successfully authenticated by a central RADIUS server. While authentication for a MAC address is in progress, all traffic is blocked until authentication is completed. On successful authentication, the RADIUS server may optionally assign VLAN settings for the switch port.
- When enabled on a port, the authentication process sends a Password Authentication Protocol (PAP) request to a configured RADIUS server. The username and password are both equal to the MAC address being authenticated.
- On the RADIUS server, PAP username and passwords must be configured in the MAC address format XX-XX-XX-XX-XX-XX (all in upper case).
- Authenticated MAC addresses are stored as dynamic entries in the switch secure MAC address table and are removed when the aging time expires. The maximum number of secure MAC addresses supported for the switch system is 1024.
- Configured static MAC addresses are added to the secure address table when seen on a switch port. Static addresses are treated as authenticated without sending a request to a RADIUS server.
- When port status changes to down, all MAC addresses are cleared from the secure MAC address table. Static VLAN assignments are not restored.
- The RADIUS server may optionally return a VLAN identifier list to be applied to the switch port. The following attributes need to be configured on the RADIUS server.

  -Tunnel-Type = VLAN

  -Tunnel-Medium-Type = 802

  -Tunnel-Private-Group-ID = 1u,2t [VLAN ID list]

The VLAN identifier list is carried in the RADIUS "**Tunnel-Private-Group-ID**" attribute. The VLAN list can contain multiple VLAN identifiers in the format "1u,2t,3u" where "u" indicates an untagged VLAN and "t" a tagged VLAN.

4.11.12.1 Network Access Configuration

MAC address authentication is configured on a per-port basis, however there are two configurable parameters that apply globally to all ports on the switch.

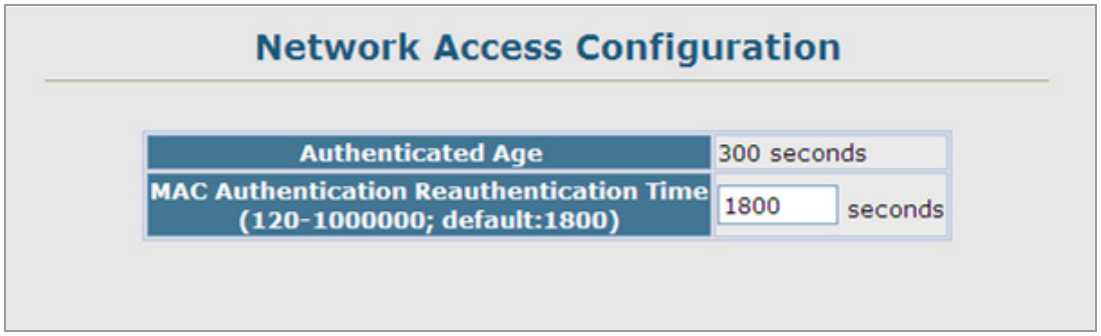


Figure 4-11-30 Settings screenshot

The page includes the following fields:

Object	Description
Authenticated Age	The secure MAC address table aging time. This parameter setting is the same as switch MAC address table aging time and is only configurable from the Address Table, Aging Time web page. (Default: **300** seconds)
MAC Authentication Reauthentication Time	Sets the time period after which a connected MAC address must be reauthenticated. When the reauthentication time expires for a secure MAC address, it is reauthenticated with the RADIUS server. During the reauthentication process traffic through the port remains unaffected. Range: 120-1000000 seconds; Default: **1800** seconds

4.11.12.2 Network Access Port Configuration

Configures MAC authentication on switch ports, including setting the maximum MAC count, applying a MAC address filter, and enabling dynamic VLAN assignment.

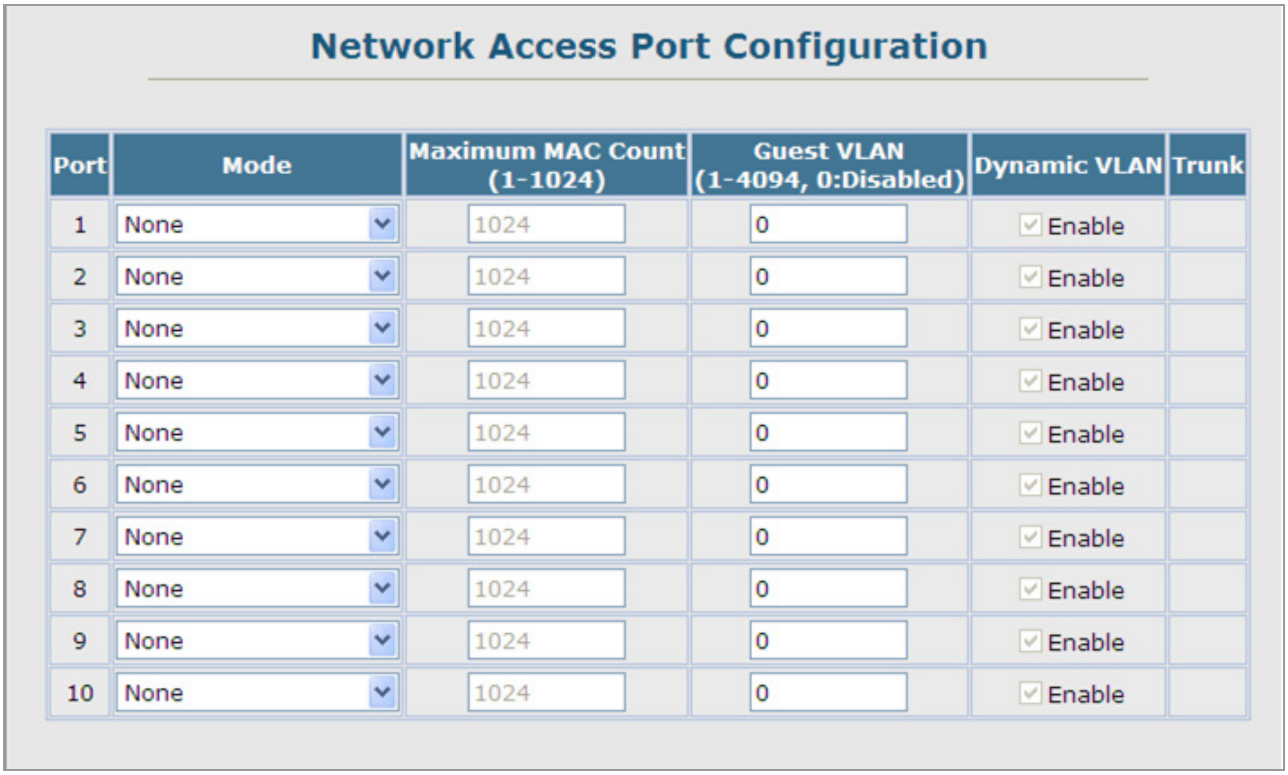


Figure 4-11-31 Settings screenshot

The page includes the following fields:

Object	Description
Mode	Enables MAC authentication on a port. (Default: **None**)
Maximum MAC Count	Sets the maximum number of MAC addresses that can be authenticated on a port. The maximum number of MAC addresses per port is **2048**, and the maximum number of secure MAC addresses supported for the switch system is **1024**. When the limit is reached, all new MAC addresses are treated as an authentication failure. (Range: 1-1024; Default: **1024**)
Guest VLAN	Specifies the VLAN to be assigned to the port when MAC Authentication through 802.1X fails. (Default: **Disabled**; Range: 1-4094) The VLAN must already be created and active (see "**Creating VLANs**"). Also, when used with 802.1X authentication, intrusion action must be set for "**Guest VLAN**" (see "**Configuring Port Settings for 802.1X**")
Dynamic VLAN	Enables dynamic VLAN assignment for an authenticated port. When enabled, any VLAN identifiers returned by the RADIUS server are applied to the port, providing the VLANs have already been created on the switch. (GVRP is not used to create the VLANs.) (Default: **Enabled**)

The VLAN settings specified by the first authenticated MAC address are implemented for a port. Other authenticated MAC addresses on the port must have the same VLAN configuration, or they are treated as authentication failures.
If dynamic VLAN assignment is enabled on a port and the RADIUS server returns no VLAN configuration, the authentication is still treated as a success, and the host assigned to the default untagged VLAN.
When the dynamic VLAN assignment status is changed on a port, all authenticated addresses are cleared from the secure MAC address table.

Note

MAC authentication cannot be configured on trunk ports. Ports configured as trunk members are indicated on the in the "Trunk" column.

4.11.12.3 Network Access MAC Address Information

Authenticated MAC addresses are stored in the secure MAC address table. Information on the secure MAC entries can be displayed and selected entries removed from the table.

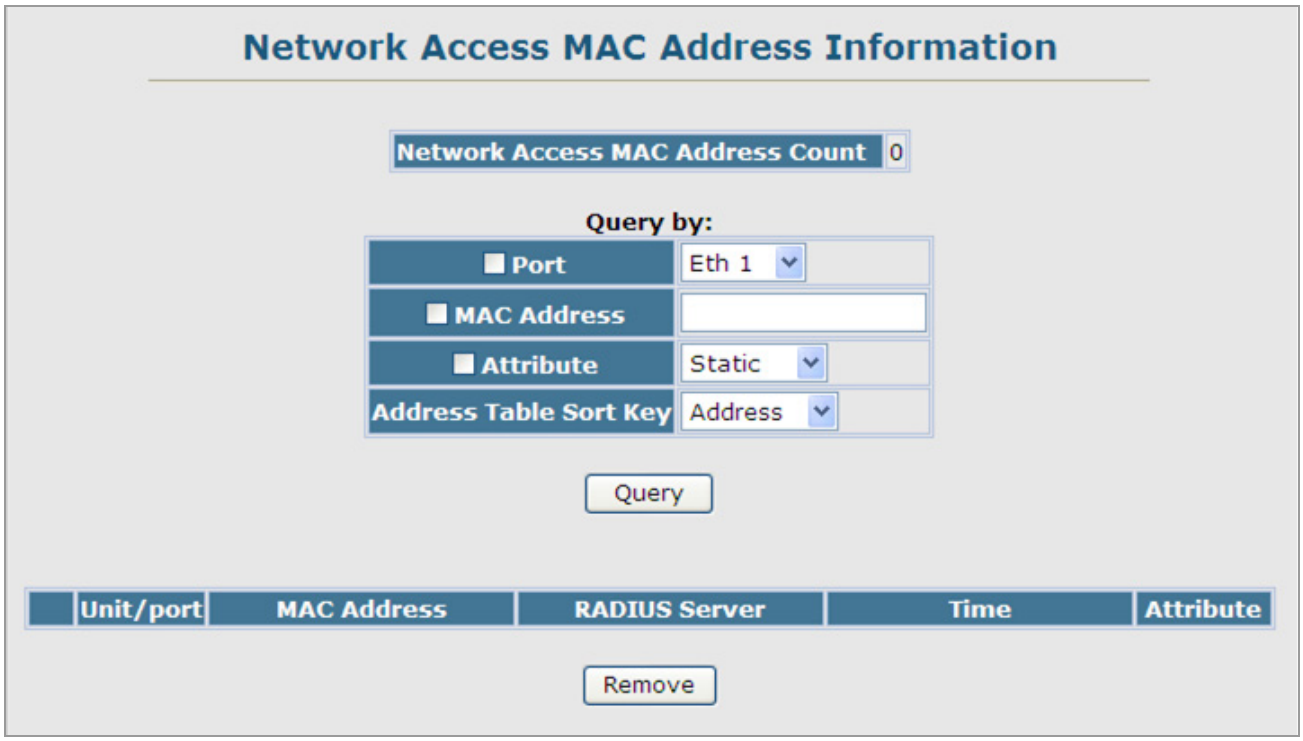


Figure 4-11-32 Settings screenshot

The page includes the following fields:

Object	Description
Network Access MAC Address Count	The number of MAC addresses currently in the secure MAC address table.
Query By	Specifies parameters to use in the MAC address query.
Port	Specifies a port interface.
MAC Address	Specifies a single MAC address information.
Attribute	Displays static or dynamic addresses.
Address Table Sort Key	Sorts the information displayed based on MAC address or port interface.
Unit/Port	The port interface associated with a secure MAC address.
MAC Address	The authenticated MAC address.
RADIUS Server	The IP address of the RADIUS server that authenticated the MAC address.
Time	The time when the MAC address was last authenticated.
Attribute	Indicates a static or dynamic address.
Remove	Click the Remove button to remove selected MAC addresses from the secure MAC address table.

4.11.13 Access Control Lists

Access Control Lists (ACL) provide packet filtering for IP frames (based on address, protocol, Layer 4 protocol port number or TCP control code) or any frames (based on MAC address or Ethernet type). To filter incoming packets, first create an access list, add the required rules, and then bind the list to a specific port.

Configuring Access Control Lists –

An ACL is a sequential list of permit or deny conditions that apply to IP addresses, MAC addresses, or other more specific criteria. This switch tests ingress or egress packets against the conditions in an ACL one by one. A packet will be accepted as soon as it matches a permit rule, or dropped as soon as it matches a deny rule. If no rules match for a list of all permit rules, the packet is dropped; and if no rules match for a list of all deny rules, the packet is accepted.

The following filtering modes are supported:

- **Standard IP ACL mode (STD-ACL)** filters packets based on the source IP address.
- **Extended IP ACL mode (EXT-ACL)** filters packets based on source or destination IP address, as well as protocol type and protocol port number. If the TCP protocol is specified, packets can also be filtered based on the TCP control code.
- **MAC ACL mode (MAC-ACL)** filters packets based on the source or destination MAC address and the Ethernet frame type (RFC 1060).

Command Usage

The following restrictions apply to ACLs:

- The maximum number of ACLs is 32.
- Each ACL can have up to 100 rules. However, due to resource restrictions, the average number of rules bound to the ports should not exceed 20.

The order in which active ACLs are checked is as follows:

- User-defined rules in the Egress IP ACL for egress ports.
- User-defined rules in the Ingress IP ACL for ingress ports.
- Explicit default rule (permit any any) in the ingress IP ACL for ingress ports.
- If no explicit rule is matched, the implicit default is permit all.

4.11.13.1 ACL Configuration

Use the ACL Configuration page to designate the name and type of an ACL.

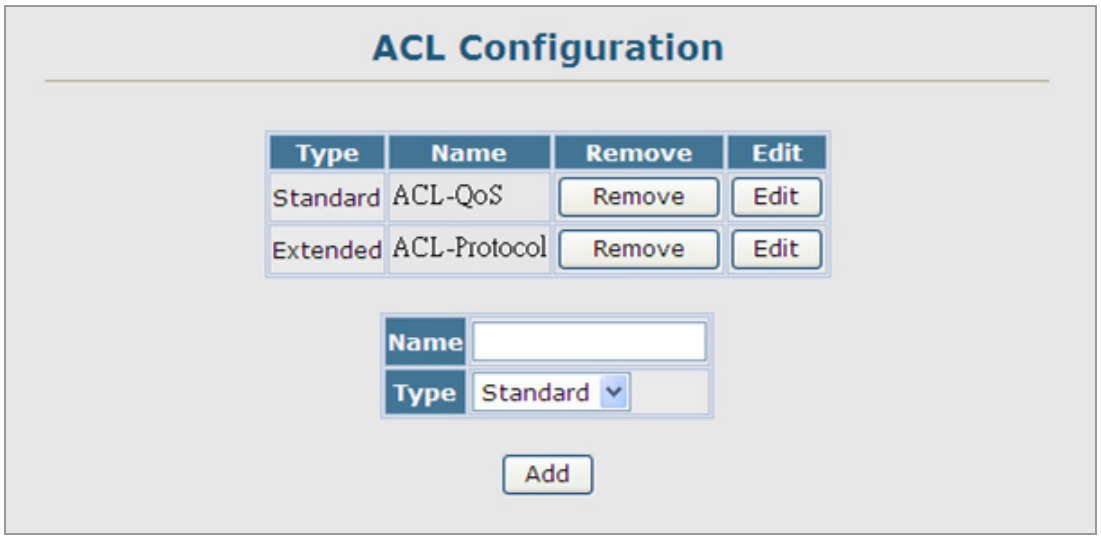


Figure 4-11-33 Settings screenshot

Select Security, ACL, Configuration. Enter an ACL name in the Name field, select the list type (IP Standard, IP Extended, or MAC), and click Add to open the configuration page for the new list.

The page includes the following fields:

Object	Description	
Name	Name of the ACL. (Maximum length: 15 characters)	
Type	There are three filtering modes:	
	--Standard	IP ACL mode that filters packets based on the source IP address.
	–- Extended	IP ACL mode that filters packets based on source or destination IP address, as well as protocol type and protocol port number. If the "TCP" protocol is specified, then you can also filter packets based on the TCP control code.
	–- MAC	MAC ACL mode that filters packets based on the source or destination MAC address and the Ethernet frame type (RFC 1060).

4.11.13.2 Configure a Standard ACL

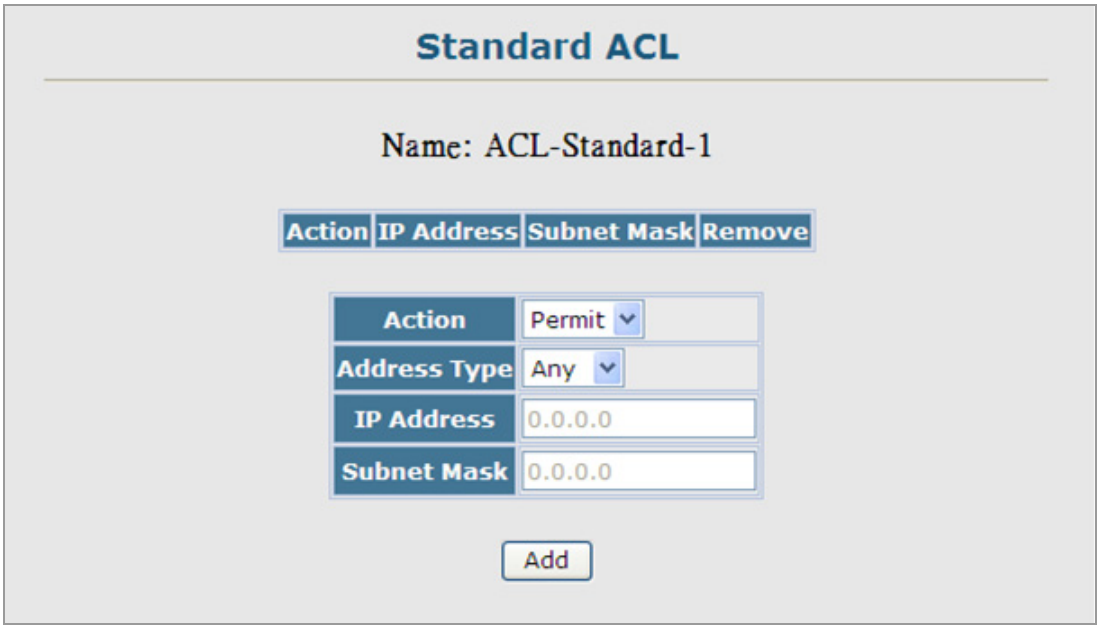


Figure 4-11-34 Settings screenshot

1. Specify the action (i.e., Permit or Deny).
2. Select the address type (Any, Host, or IP). If you select "Host," enter a specific address.
3. If you select "IP," enter a subnet address and the mask for an address range.
4. Then click Add.

The page includes the following fields:

Object	Description
Action	An ACL can contain any combination of permit or deny rules.
Address Type	Specifies the source IP address. Use "Any" to include all possible addresses, "Host" to specify a specific host address in the Address field, or "IP" to specify a range of addresses with the Address and SubMask fields. (Options: Any, Host, IP; Default: Any)
IP Address	Source IP address.
Subnet Mask	A subnet mask containing four integers from 0 to 255, each separated by a period. The mask uses 1 bits to indicate "match" and 0 bits to indicate "ignore." The mask is bitwise ANDed with the specified source IP address, and compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

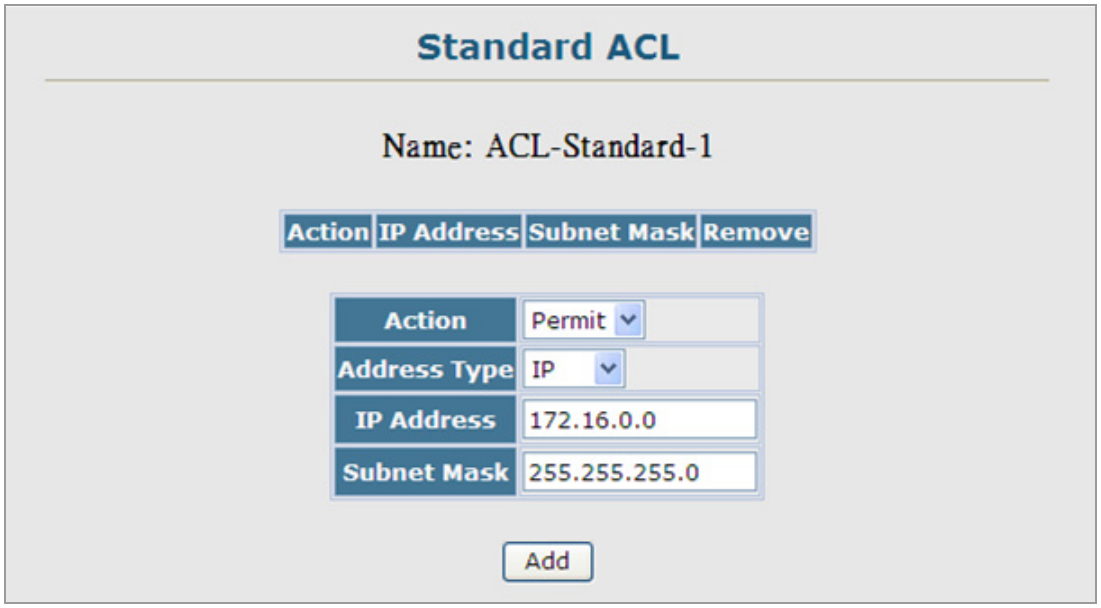


Figure 4-11-35 Settings screenshot

Figure 4-11-36 Settings screenshot

4.11.13.3 Extended ACL

Specify the action (i.e., Permit or Deny). Specify the source and/or destination addresses. Select the address type (Any, Host, or IP). If you select "Host," enter a specific address. If you select "IP," enter a subnet address and the mask for an address range. Set any other required criteria, such as service type, protocol type, or TCP control code. Then click Add.

The page includes the following fields:

Object	Description
Action	An ACL can contain any combination of permit or deny rules. (Default: **Permit** rules)
Source/Destination Address Type	Specifies the source or destination IP address. Use "Any" to include all possible addresses, "Host" to specify a specific host address in the Address field, or "IP" to specify a range of addresses with the Address and SubMask fields. Options: **Any, Host**, **IP;** Default: Any
Source/Destination IP Address	Source or destination IP address.
Source/Destination Subnet Mask	Subnet mask for source or destination address. (See the description for Subnet Mask.)
Service Type	Packet priority settings based on the following criteria: -**Precedence** – IP precedence level. (Range: 0-7) -**DSCP** – DSCP priority level. (Range: 0-63)
Protocol	Specifies the protocol type to match as TCP, UDP or Others, where others indicates a specific protocol number (0-255). Options: TCP, UDP, Others; Default: **TCP**
Source/Destination Port Start	Source/destination port number for the specified protocol type. (Range: 0-65535)
Source/Destination Port End	Upper bound of the protocol port range. (Range: 0-65535)
Control Flag	Decimal number (representing a bit string) that specifies flag bits in byte 14 of the TCP header. (Range: 0-63) You can specify both Precedence and ToS in the same rule. However, if DSCP is used, then neither Precedence nor ToS can be specified. The following control codes may be specified: -1 (fin) – Finish -2 (syn) – Synchronize -4 (rst) – Reset -8 (psh) – Push -16 (ack) – Acknowledgement -32 (urg) – Urgent pointer To define more than one control code, set the equivalent binary bit to "1" to indicate the required codes. For example, to set both SYN and ACK valid, set the control flag to 18.

4.11.13.4 MAC ACL

Egress MAC ACLs only work for destination-mac-known packets, not for multicast, broadcast, or destination-mac-unknown packets.

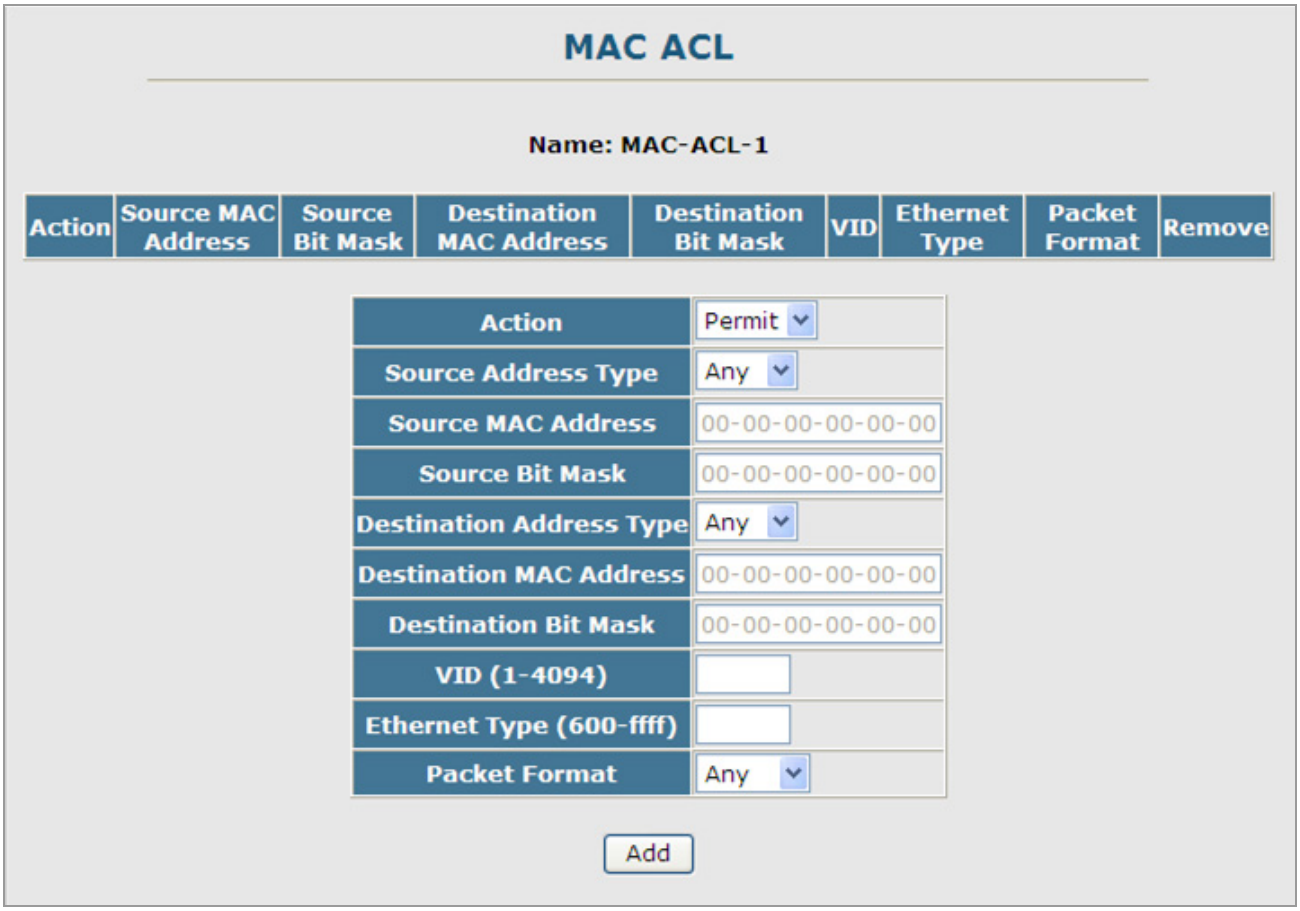


Figure 4-11-37 Settings screenshot

1. Specify the action (i.e., Permit or Deny).
2. Specify the source and/or destination addresses.
3. Select the address type (Any, Host, or MAC).
4. If you select "Host," enter a specific address (e.g., 11-22-33-44-55-66).
5. If you select "MAC," enter a base address and a hexadecimal bitmask for an address range.
6. Set any other required criteria, such as VID, Ethernet type, or packet format.
7. Then click Add.

The page includes the following fields:

Object	Description
Action	An ACL can contain any combination of permit or deny rules.
Source/Destination Address Type	Use "Any" to include all possible addresses, "Host" to indicate a specific MAC address, or "MAC" to specify an address range with the Address and Bitmask

	fields. (Options: Any, Host, MAC; Default: Any)
Source/Destination MAC Address	Source or destination MAC address.
Source/Destination Bit Mask	Hexadecimal mask for source or destination MAC address.
VID	VLAN ID. (Range: 1-4094)
Ethernet Type	This option can only be used to filter Ethernet II formatted packets. (Range: 600-fff hex.) A detailed listing of Ethernet protocol types can be found in RFC 1060. A few of the more common types include 0800 (IP), 0806 (ARP), 8137 (IPX).
Packet Format	This attribute includes the following packet types: **-Any** – Any Ethernet packet type. **-eth2** – Ethernet II packets. **-802.3** – Ethernet 802.3 packets.

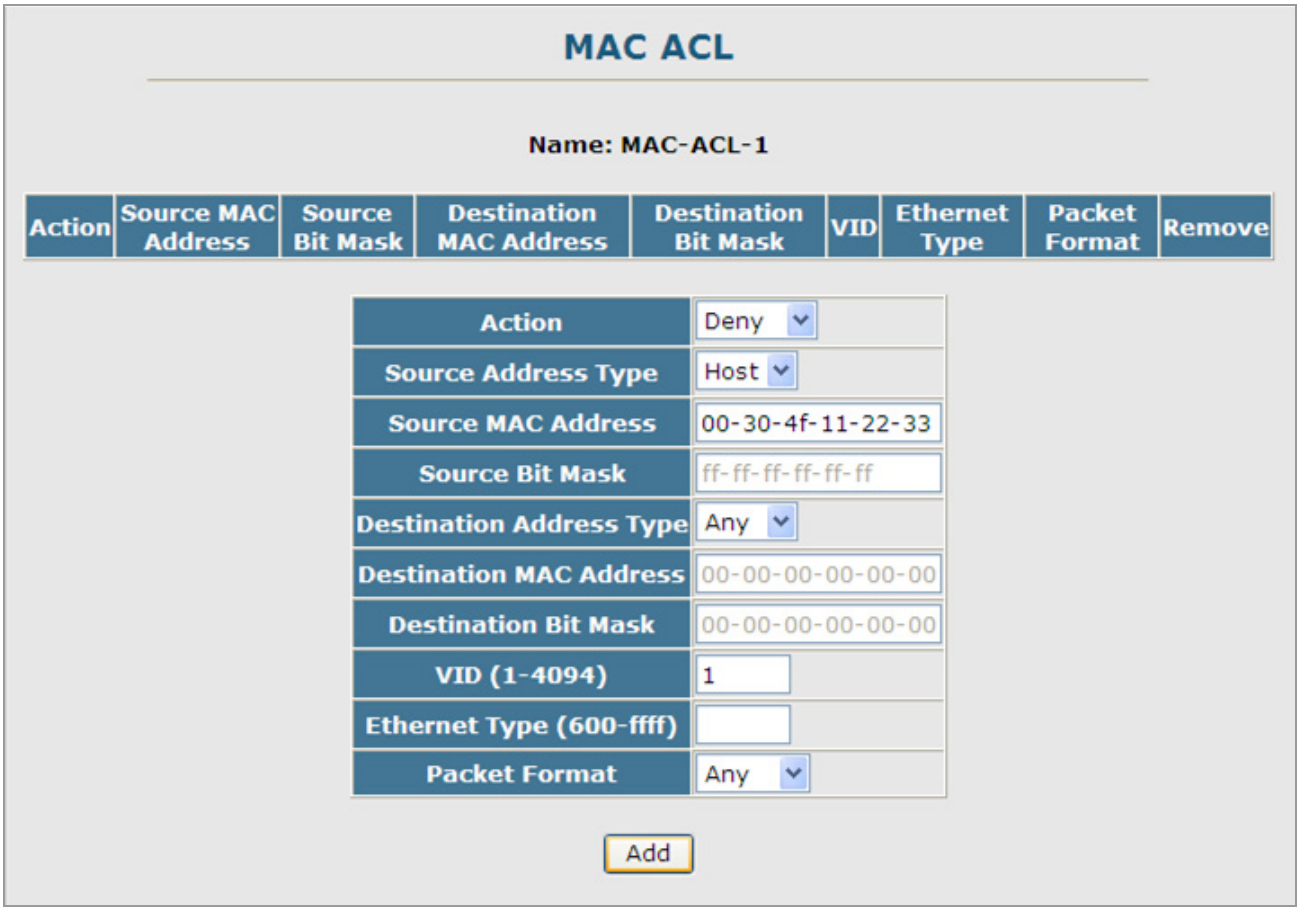


Figure 4-11-38 Settings screenshot

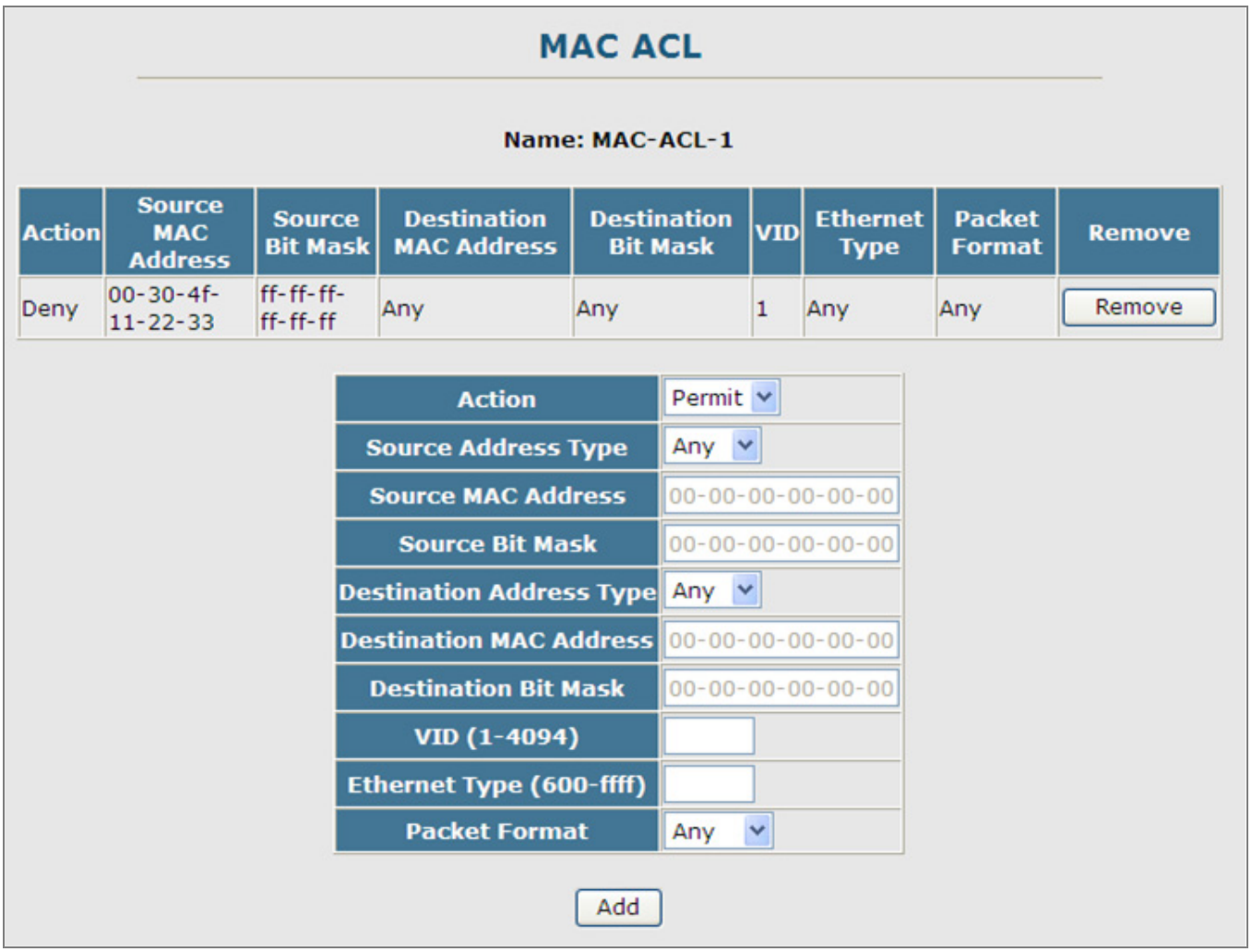


Figure 4-11-39 Settings screenshot

4.11.13.5 ACL Port Binding

After configuring the Access Control Lists (ACL), you can bind the ports that need to filter traffic to the appropriate ACLs. You can assign one IP access list to any port – IP ingress or MAC ingress.

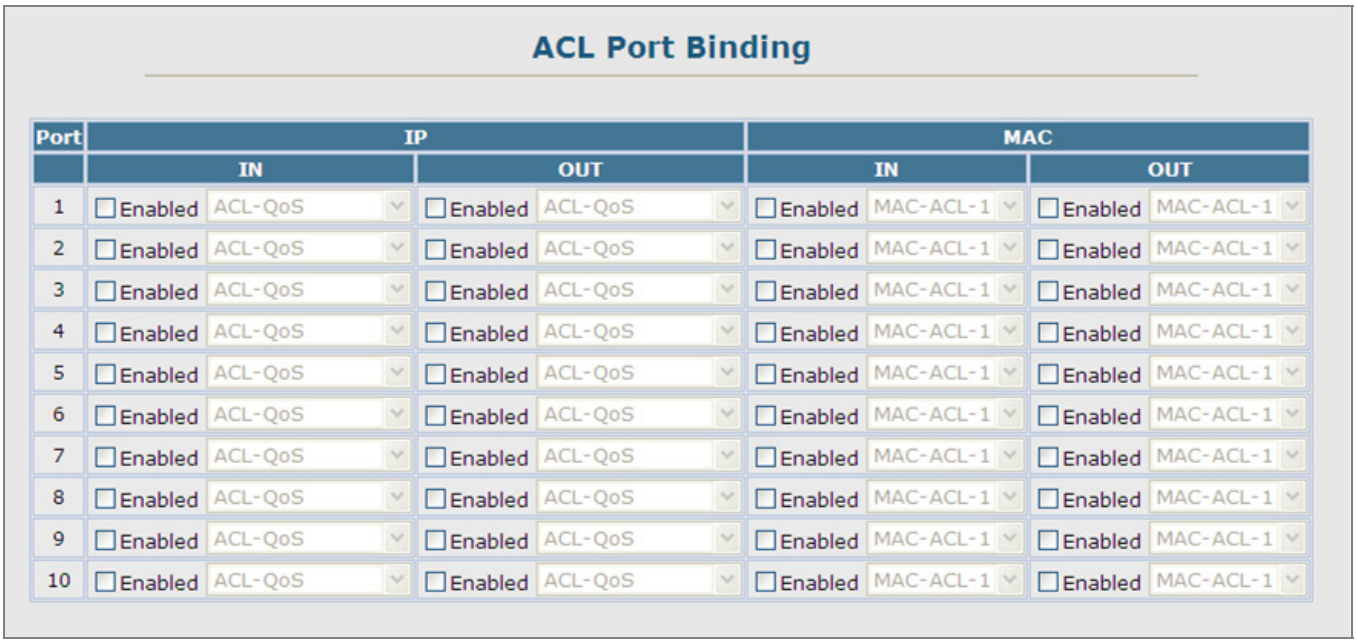


Figure 4-11-40 Settings screenshot

1. Click Security, ACL, Port Binding.
2. Mark the Enable field for the port you want to bind to an ACL for ingress or egress traffic, select the required ACL from the drop-down list, then click Apply.

The page includes the following fields:

Object	Description
Port	Fixed port or SFP module. SGSW-2840/SGSW-2840P: Range: 1-28 SGSD-1022/SGSD-1022P: Range: 1-10
IP	Specifies the IP ACL to bind to a port.
MAC	Specifies the MAC ACL to bind to a port.
IN	ACL for ingress packets.
ACL Name	Name of the ACL.

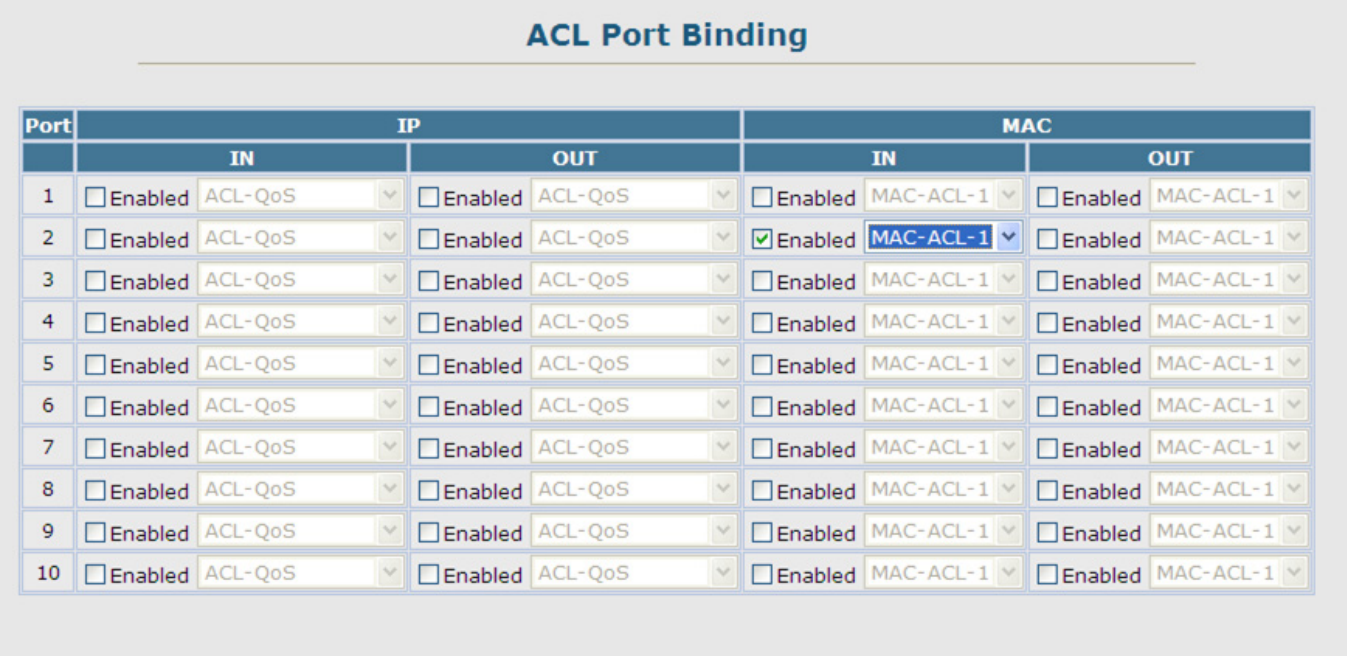


Figure 4-11-41 Settings screenshot

4.11.14 IP Filter

You can create a list of up to 16 IP addresses or IP address groups that are allowed management access to the Managed Switch through the web interface, SNMP, or Telnet.

Command Usage

- The management interfaces are open to all IP addresses by default. Once you add an entry to a filter list, access to that interface is restricted to the specified addresses.
- If anyone tries to access a management interface on the switch from an invalid address, the switch will reject the connection, enter an event message in the system log, and send a trap message to the trap manager.
- IP address can be configured for SNMP, web and Telnet access respectively. Each of these groups can include up to five different sets of addresses, either individual addresses or address ranges.
- When entering addresses for the same group (i.e., SNMP, web or Telnet), the switch will not accept overlapping address ranges. When entering addresses for different groups, the switch will accept overlapping address ranges.
- You cannot delete an individual address from a specified range. You must delete the entire range, and reenter the addresses.
- You can delete an address range just by specifying the start address, or by specifying both the start address and end address.

4.11.14.1 Web IP Filter

You can create IP address groups that are allowed management access to the Managed Switch through the Web interface.

Figure 4-11-42 IP Filter page screenshot

1. Click Security, IP Filter.
2. Enter the IP addresses or range of addresses that are allowed management access to an interface, and click Add Web IP Filtering Entry to update the filter list.

The page includes the following fields:

Object	Description
Web IP Filter	Configures IP address(es) for the web group.
Start IP Address	A single IP address, or the starting address of a range.
End IP Address	The end address of a range.
Add/Remove Filtering Entry	Adds/removes an IP address from the list.

4.11.14.2 SNMP IP Filter

You can create IP address groups that are allowed management access to the Managed Switch through the SNMP application.

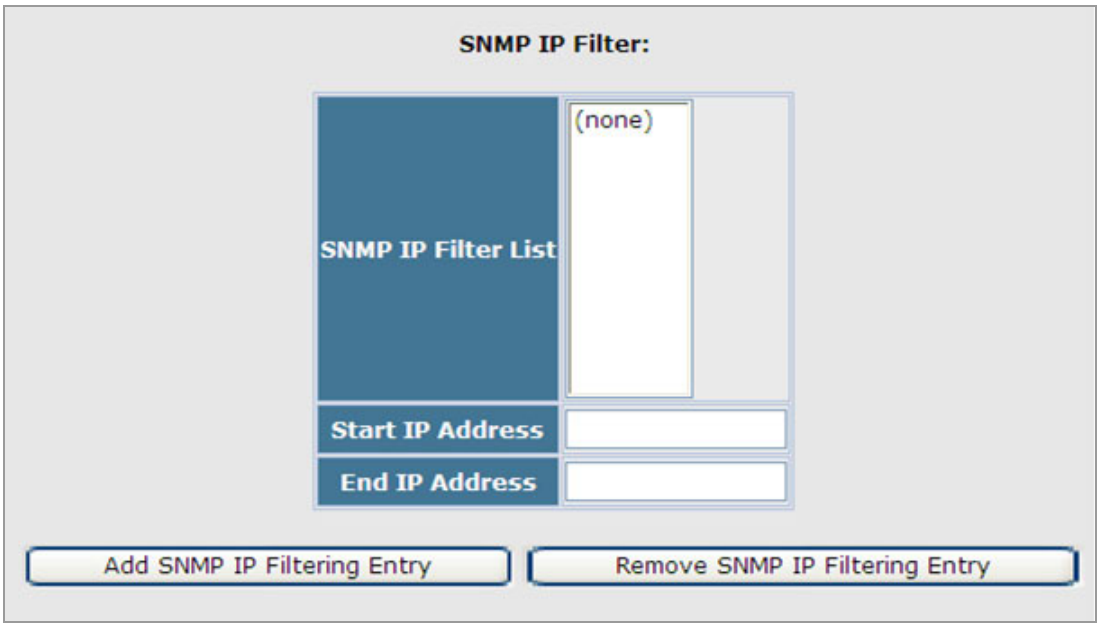


Figure 4-11-43 SNMP IP Filter page screenshot

1. Click Security, IP Filter.
2. Enter the IP addresses or range of addresses that are allowed management access to an interface, and click Add SNMP IP Filtering Entry to update the filter list.

The page includes the following fields:

Object	Description
SNMP IP Filter	Configures IP address(es) for the SNMP group.
Start IP Address	A single IP address, or the starting address of a range.
End IP Address	The end address of a range.
Add/Remove Filtering Entry	Adds/removes an IP address from the list.

4.11.14.3 Telnet IP Filter

You can create IP address groups that are allowed management access to the Managed Switch through telnet.

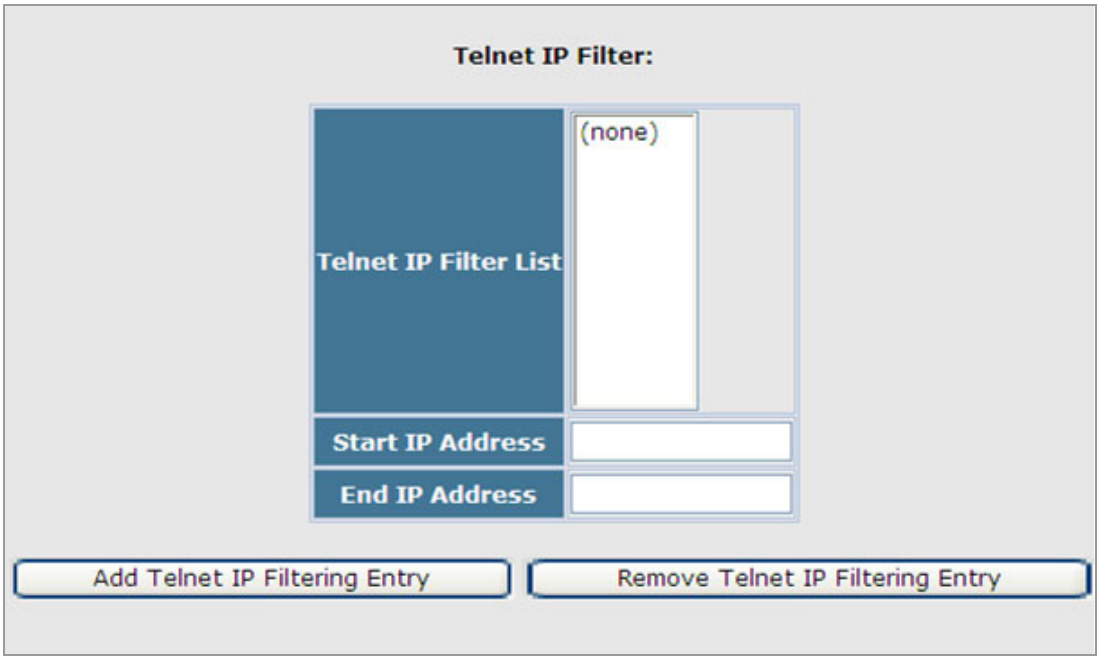


Figure 4-11-44 Telnet IP Filter page screenshot

1. Click Security, IP Filter.
2. Enter the IP addresses or range of addresses that are allowed management access to an interface, and click Add Telnet IP Filtering Entry to update the filter list.

The page includes the following fields:

Object	Description
Telnet IP Filter	Configures IP address(es) for the Telnet group.
Start IP Address	A single IP address, or the starting address of a range.

End IP Address	The end address of a range.
Add/Remove Filtering Entry	Adds/removes an IP address from the list.

4.11.15 DHCP Snooping

The addresses assigned to DHCP clients on unsecure ports can be carefully controlled using the dynamic bindings registered with DHCP Snooping (or using the static bindings configured with IP Source Guard). DHCP snooping allows a switch to protect a network from rogue DHCP servers or other devices which send port-related information to a DHCP server. This information can be useful in tracking an IP address back to a physical port.

Command Usage

- Network traffic may be disrupted when malicious DHCP messages are received from an outside source. DHCP snooping is used to filter DHCP messages received on a non-secure interface from outside the network or firewall. When DHCP snooping is enabled globally and enabled on a VLAN interface, DHCP messages received on an untrusted interface from a device not listed in the DHCP snooping table will be dropped.

- Table entries are only learned for trusted interfaces. An entry is added or removed dynamically to the DHCP snooping table when a client receives or releases an IP address from a DHCP server. Each entry includes a MAC address, IP address, lease time, VLAN identifier, and port identifier.

- The rate limit for the number of DHCP messages that can be processed by the switch is 100 packets per second. Any DHCP packets in excess of this limit are dropped.

- When DHCP snooping is enabled, DHCP messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCP snooping.

- Filtering rules are implemented as follows:

  - If the global DHCP snooping is disabled, all DHCP packets are forwarded.

  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, all DHCP packets are forwarded for a trusted port. If the received packet is a DHCP ACK message, a dynamic DHCP snooping entry is also added to the binding table.

  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is not trusted, it is processed as follows:
    - If the DHCP packet is a reply packet from a DHCP server (including OFFER, ACK or NAK messages), the packet is dropped.
    - If the DHCP packet is from a client, such as a DECLINE or RELEASE message, the switch forwards the packet only if the corresponding entry is found in the binding table.
    - If the DHCP packet is from a client, such as a DISCOVER, REQUEST, INFORM, DECLINE or RELEASE message, the packet is forwarded if MAC address verification is disabled. However, if MAC address verification is enabled, then the packet will only be forwarded if the client's hardware address stored in the DHCP packet is the same as the source MAC address in the Ethernet header.
    - If the DHCP packet is not a recognizable type, it is dropped.
  - If a DHCP packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.

- If a DHCP packet is from server is received on a trusted port, it will be forwarded to both trusted and untrusted ports in the same VLAN.

- If the DHCP snooping is globally disabled, all dynamic bindings are removed from the binding table.

- Additional considerations when the switch itself is a DHCP client – The port(s) through which the switch submits a client request to the DHCP server must be configured as trusted. Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCP server. Also, when the switch sends out DHCP client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCP server, any packets received from untrusted ports are dropped.

4.11.15.1 DHCP Snooping Configuration

Use the DHCP Snooping Configuration page to enable DHCP Snooping globally on the Managed Switch, or to configure MAC Address Verification.

Figure 4-11-45 DHCP Snooping Configuration page screenshot

The page includes the following fields:

Object	Description
• **DHCP Snooping Status**	Enables DHCP snooping globally. (Default: Disabled)
• **DHCP Snooping MAC-Address Verification**	Enables or disables MAC address verification. DHCP packets will be dropped if the source MAC address in the Ethernet header of the packet is not same as the client's hardware address in the DHCP packet.

4.11.15.2 DHCP Snooping VLAN Configuration

Enables DHCP snooping on the specified VLAN.

Command Usage

- When DHCP snooping is enabled globally on the switch, and enabled on the specified VLAN, DHCP packet filtering will be performed on any untrusted ports within the VLAN.
- When the DHCP snooping is globally disabled, DHCP snooping can still be configured for specific VLANs, but the changes will not take effect until DHCP snooping is globally re-enabled.
- When DHCP snooping is globally enabled, and DHCP snooping is then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

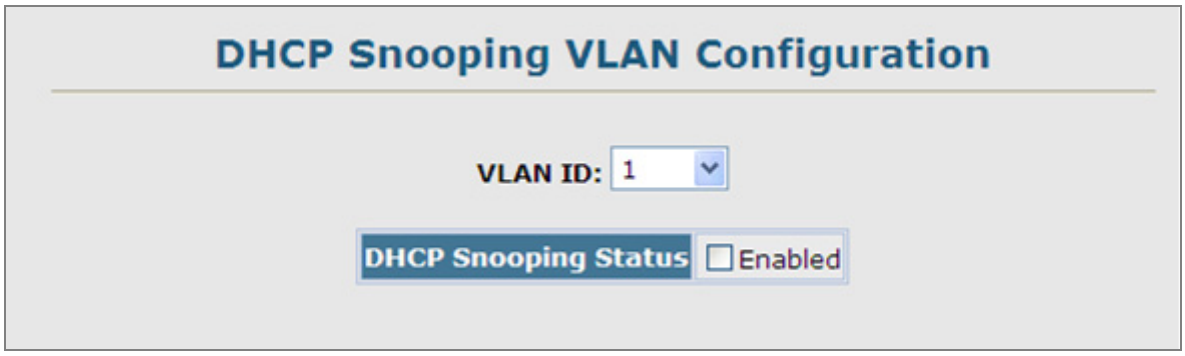


Figure 4-11-46 DHCP Snooping VLAN Configuration page screenshot

The page includes the following fields:

Object	Description
• **VLAN ID**	ID of a configured VLAN. (Range: 1-4094)
• **DHCP Snooping Status**	Enables or disables DHCP snooping for the selected VLAN.

4.11.15.3 Information Option Configuration

DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to DHCP servers. Known as DHCP Option 82, it allows compatible DHCP servers to use the information when assigning IP addresses, or to set other services or policies for clients. It is also an effective tool in preventing malicious network attacks from attached clients on DHCP services, such as IP Spoofing, Client Identifier Spoofing, MAC Address Spoofing, and Address Exhaustion.

Command Usage

- DHCP Snooping must be enabled for Option 82 to function.
- When Option 82 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server.
- If Option 82 is enabled on the switch, client information may be included in any relayed request packet.
- DHCP request packets are flooded onto all attached VLANs other than the inbound VLAN under the following situations:

- DHCP snooping is disabled.
- The request packet contains a valid relay agent address field.

DHCP reply packets received by the relay agent (that is, this switch) are handled in the following way:

1. When the relay agent receives a DHCP reply packet with Option 82 information, it first ensures that the packet is destined for it, and then removes the Option 82 field from the packet.
2. If the DHCP packet's broadcast flag is on, the reply packet is broadcast to all attached VLANs, excluding that through which the reply packet was received. If the DHCP packet's broadcast flag is off, the switch uses the Option 82 information to identify the interface connected to the requesting client and unicasts the reply packet to the client.

DHCP reply packets are flooded onto all attached VLANs other than the inbound VLAN under the following situations:

- The reply packet does not contain Option 82 information.
- The reply packet contains a valid relay agent address field (that is not the address of this switch) or a zero relay address.

- In some cases, the Managed Switch may receive DHCP packets from a client that already includes DHCP Option 82 information. The switch can be configured to set the action policy for these packets. Either the Managed Switch can discard the Option 82 information, keep the existing information, or replace it with the switch's relay information.

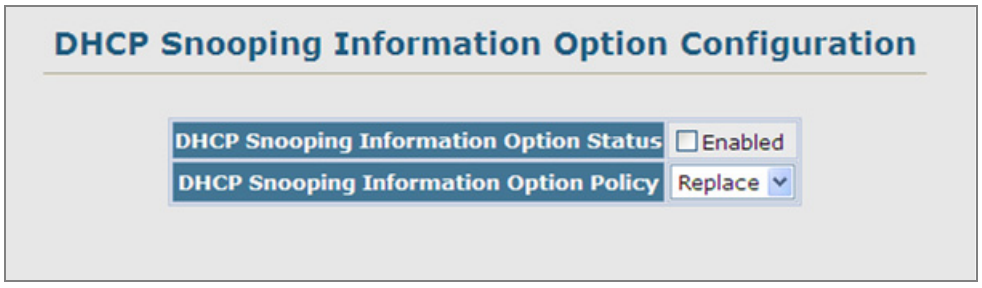


Figure 4-11-47 DHCP Snooping Information Option Configuration page screenshot

The page includes the following fields:

Object	Description
• **DHCP Snooping Information Option Status**	Enables or disables DHCP Option 82 information relay. (Default: Disabled)
• **DHCP Snooping Information Option Policy**	Sets the DHCP snooping information option policy for DHCP client packets that include Option 82 information. • **Drop** Discards the Option 82 information in a packet and then floods it to the entire VLAN. • **Keep** Retain the Option 82 information in the client request, insert the relay agent's address (when DHCP snooping is enabled), and unicast the packet to the DHCP server. • **Replace** Replace the Option 82 information in the client's request with information about the relay agent itself, insert the relay agent's

		address (when DHCP snooping is enabled), and unicast the packet to the DHCP server. (**This is the default policy**.)

4.11.15.4 DHCP Snooping Port Configuration

Configures switch ports as trusted or untrusted.

Command Usage

- A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or firewall.
- When DHCP snooping enabled both globally and on a VLAN, DHCP packet filtering will be performed on any untrusted ports within the VLAN.
- When an untrusted port is changed to a trusted port, all the dynamic DHCP snooping bindings associated with this port are removed.
- Set all ports connected to DHCP servers within the local network or firewall to trusted state. Set all other ports outside the local network or firewall to untrusted state.

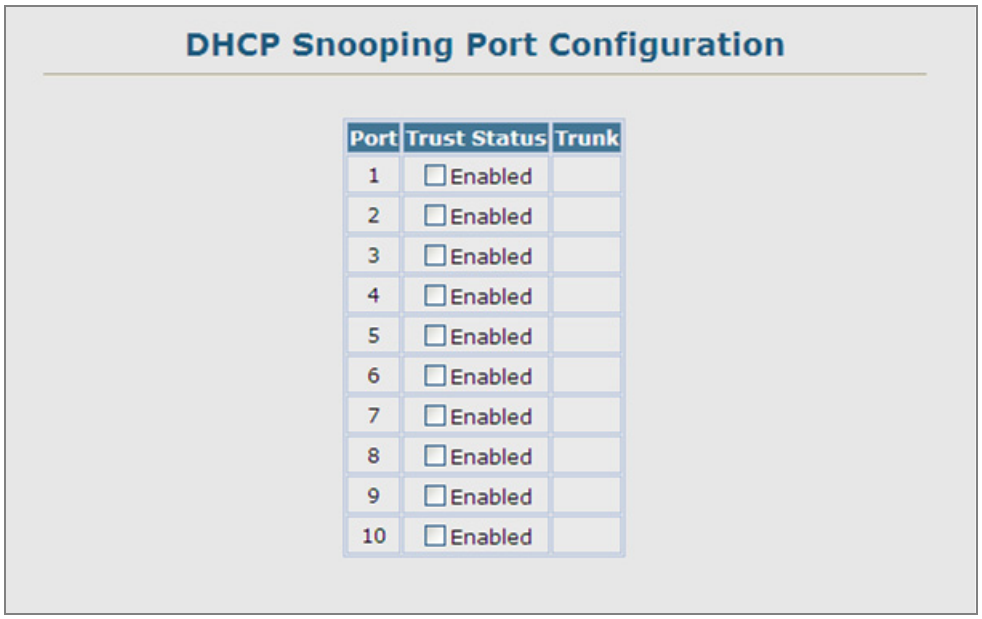


Figure 4-11-48 DHCP Snooping Port Configuration page screenshot

The page includes the following fields:

Object	Description
• **Trust Status**	Enables or disables port as trusted.

4.11.16 IP Source Guard

IP Source Guard is a security feature that filters IP traffic on network interfaces based on manually configured entries in the IP Source Guard table, or dynamic entries in the DHCP Snooping table when enabled (see "**DHCP Snooping**"). IP source guard can be used to prevent traffic attacks caused when a host tries to use the IP address of a neighbor to access the network. This section describes commands used to configure IP Source Guard.

4.11.16.1 Port Configuration

IP Source Guard is used to filter traffic on an unsecure port which receives messages from outside the network or firewall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.

Command Usage

- Setting source guard mode to **SIP (Source IP)** or **SIP-MAC (Source IP and MAC)** enables this function on the selected port. Use the SIP option to check the VLAN ID, source IP address, and port number against all entries in the binding table. Use the SIP-MAC option to check these same parameters, plus the source MAC address. If no matching entry is found, the packet is dropped.
- When enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping (see "**Configuring DHCP Snooping**"), or static addresses configured in the source guard binding table.
- If **IP source guard is enabled**, an inbound packet's **IP address (sip option)** or both its IP address and corresponding MAC address **(sip-mac option)** will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- Filtering rules are implemented as follows:
    - If the **DHCP snooping is disabled**, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, the packet will be forwarded.
    - If the **DHCP snooping is enabled**, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, or dynamic DHCP snooping binding, the packet will be forwarded.
    - If **IP source guard if enabled** on an interface for which IP source bindings have not yet been configured (neither by static configuration in the IP source guard binding table nor dynamically learned from DHCP snooping), the switch will drop all IP traffic on that port, except for DHCP packets.

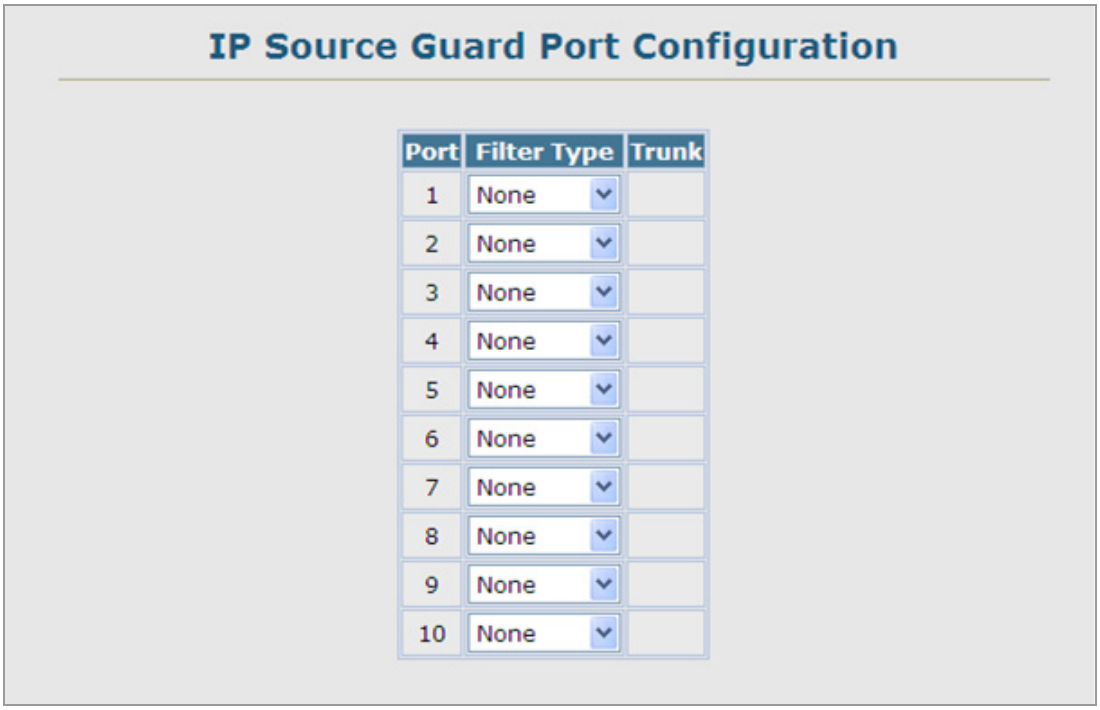


Figure 4-11-49 IP Source Guard Port Configuration page screenshot

The page includes the following fields:

Object	Description
Filter Type	Configures the switch to filter inbound traffic based source IP address, or source IP address and corresponding MAC address. • **None** Disables IP source guard filtering on the port. • **SIP** Enables traffic filtering based on IP addresses stored in the binding table. • **SIP-MAC** Enables traffic filtering based on IP addresses and corresponding MAC addresses stored in the binding table. (Default: **None**)

4.11.16.2 Static Configuration

Add a static address to the source-guard binding table. Table entries include a MAC address, IP address, lease time, entry type (Static, Dynamic), VLAN identifier, and port identifier. All static entries are configured with an infinite lease time, which is indicated with a value of zero in the table.

Command Usage

- Static addresses entered in the source guard binding table are automatically configured with an infinite lease time. Dynamic entries learned via DHCP snooping are configured by the DHCP server itself, of which static entries include a manually configured lease time.
- Static bindings are processed as follows:
  - If there is no entry with the same VLAN ID and MAC address, a new entry is added to the binding table using the type "**static IP source guard binding**."
  - If there is an entry with the same VLAN ID and MAC address, and the type of entry is **static IP source guard binding**, then the new entry will replace the old one.
  - If there is an entry with the same VLAN ID and MAC address, and the type of the entry is **dynamic DHCP snooping binding**, then the new entry will replace the old one and the entry type will be changed to static IP source guard binding.

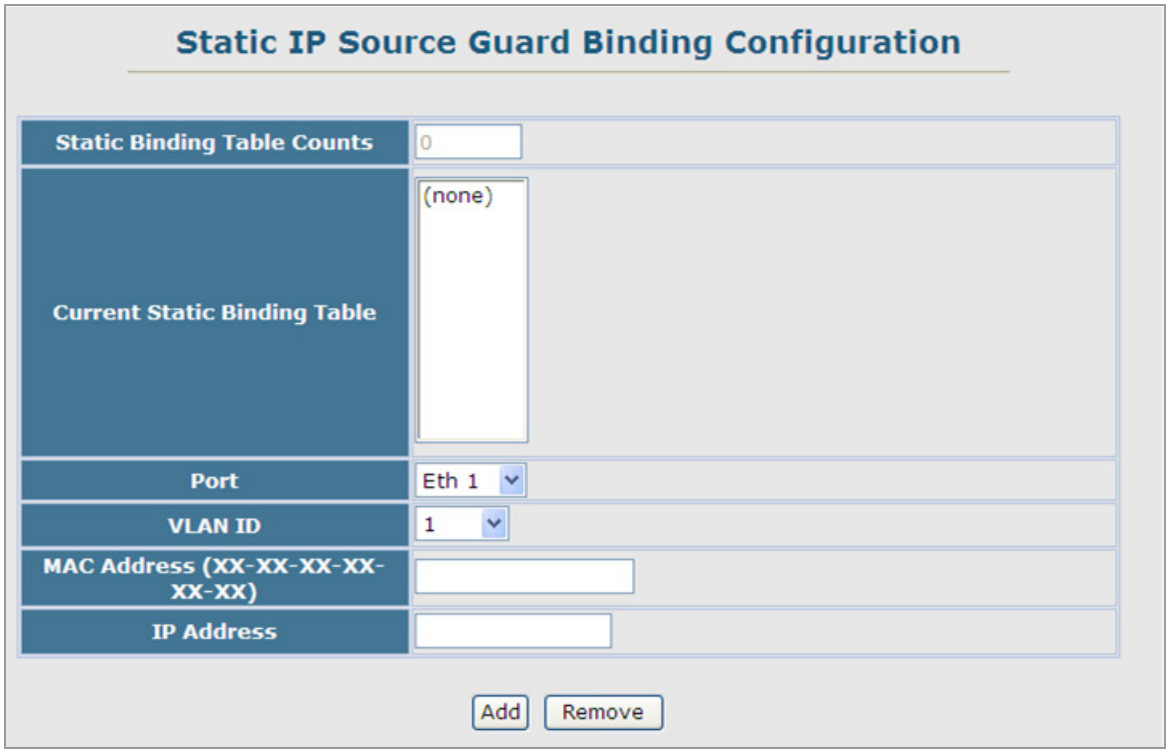


Figure 4-11-50 static IP source guard binding page screenshot

1. Click IP Source Guard, Static Configuration.
2. Select the VLAN and port to which the entry will be bound, enter the MAC address and associated IP address, then click Add.

The page includes the following fields:

Object	Description
Static Binding Table Counts	The total number of static entries in the table.
Port	Switch port number. SGSW-2840/SGSW-2840P Range: 1-28 SGSD-1022/SGSD-1022P Range: 1-10
VLAN ID	ID of a configured VLAN (Range: 1-4094)
MAC Address	A valid unicast MAC address.
IP Address	A valid unicast IP address, including classful types A, B or C.

4.11.16.3 Dynamic Information

Use the Dynamic Information page to display the source-guard binding table for a selected interface.

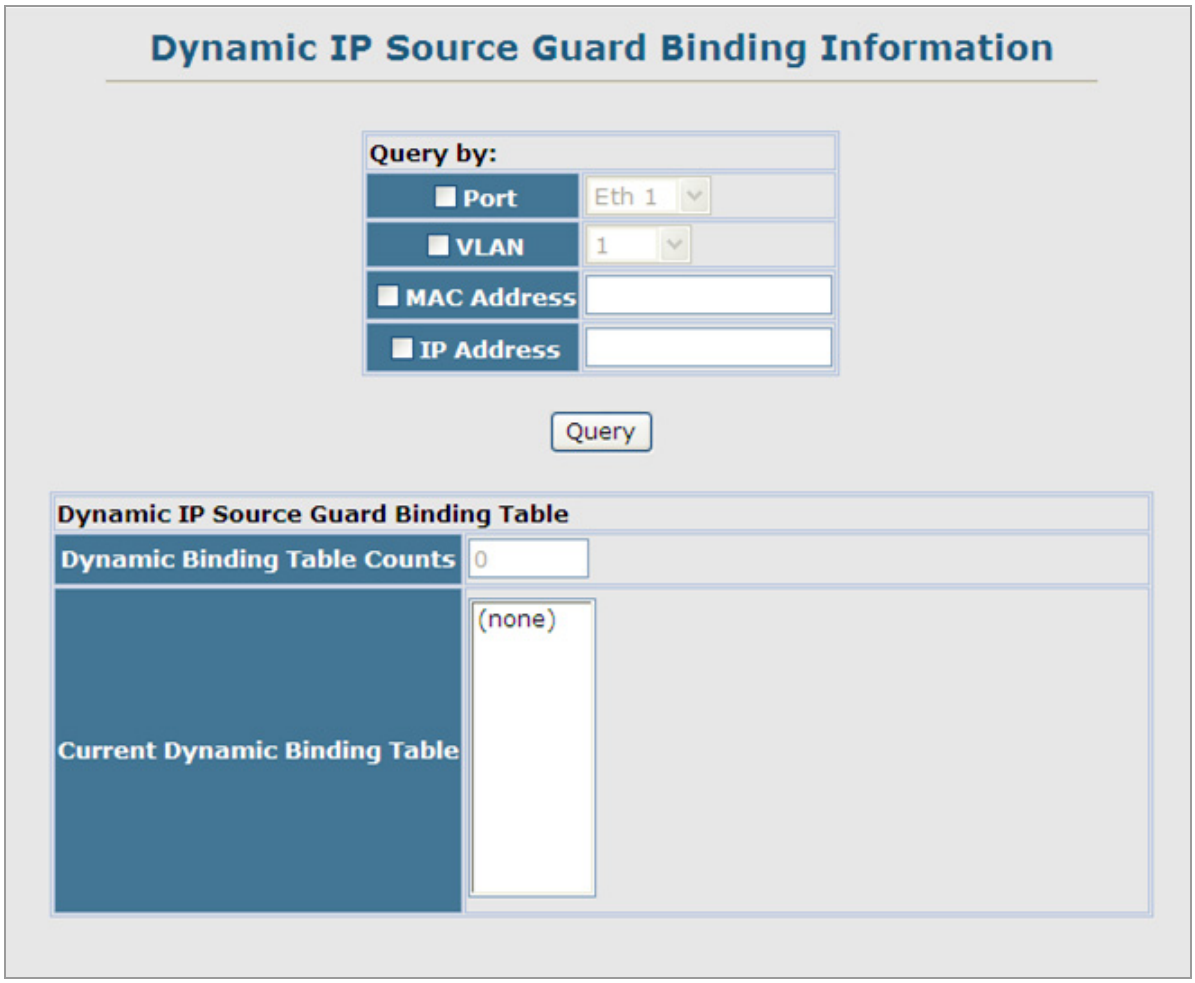


Figure 4-11-51 Dynamic IP source guard binding Information page screenshot

The page includes the following fields:

Object	Description
Query by	Select an interface to display the source-guard binding. Options: - **Port** - **VLAN** - **MAC Address** - **IP Address**
Dynamic Binding Table Counts	Displays the number of IP addresses in the source-guard binding table.
Current Dynamic Binding Table	Displays the IP addresses in the source-guard binding table.

4.12 Cluster

Switch Clustering is a method of grouping switches together to enable centralized management through a single unit. Switches that support clustering can be grouped together regardless of physical location or switch type, as long as they are connected to the same local network.

Command Usage

- A switch cluster has a "**Commander**" unit that is used to manage all other "**Member**" switches in the cluster. The management station can use both Telnet and the web interface to communicate directly with the Commander through its IP address, while the Commander manages Member switches using the cluster's "**internal**" IP addresses.
- There can be up to **36** Member switches in one cluster, and Cluster switches must be in the same IP subnet.
- Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These "**Candidate**" switches only become cluster Members when manually selected by the administrator through the management station.
- Cluster switches are limited to the same Ethernet broadcast domain.
- There can be up to 100 candidates and 36 member switches in one cluster.
- A switch can only be a member of one cluster.
- After the Commander and Members have been configured, any switch in the cluster can be managed from the web agent by choosing the desired Member ID from the Cluster drop down menu. To connect to a Member switch through the CLI, use the **rcommand**.

4.12.1 Cluster Configuration

To create a switch cluster, first be sure that clustering is enabled on the switch (the **default is enabled**), then set the switch as a **Cluster Commander**. Set a Cluster IP Pool that does not conflict with the network IP subnet. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.

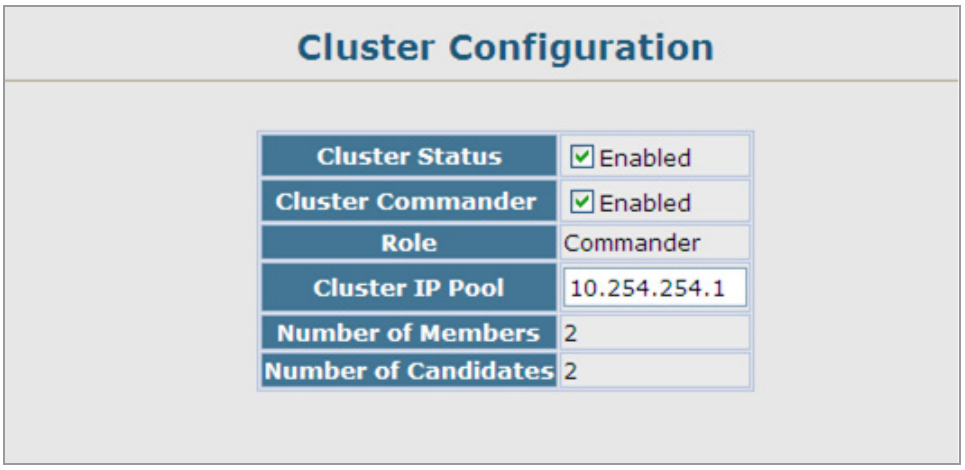


Figure 4-12-1 Cluster Configuration page screenshot

The page includes the following fields:

Object	Description
Cluster Status	Enables or disables clustering on the switch. (Default: **Enabled**)
Cluster Commander	Enables or disables the switch as a cluster Commander. (Default: **Disabled**)
Role	Indicates the current role of the switch in the cluster; either **Commander**, **Member**, or **Candidate**. (Default: **Candidate**)
Cluster IP Pool	An "**internal**" IP address pool that is used to assign IP addresses to Member switches in the cluster. Internal cluster IP addresses are in the form 10.x.x.member-ID. Only the base IP address of the pool needs to be set since Member IDs can only be between 1 and 36. **Note that you cannot change the cluster IP pool when the switch is currently in Commander mode**. Commander mode must first be disabled. (Default: **10.254.254.1**)
Number of Members	The current number of Member switches in the cluster.
Number of Candidates	The current number of Candidate switches discovered in the network that are available to become Members.

4.12.2 Cluster Member Configuration

Adds Candidate switches to the cluster as Members.

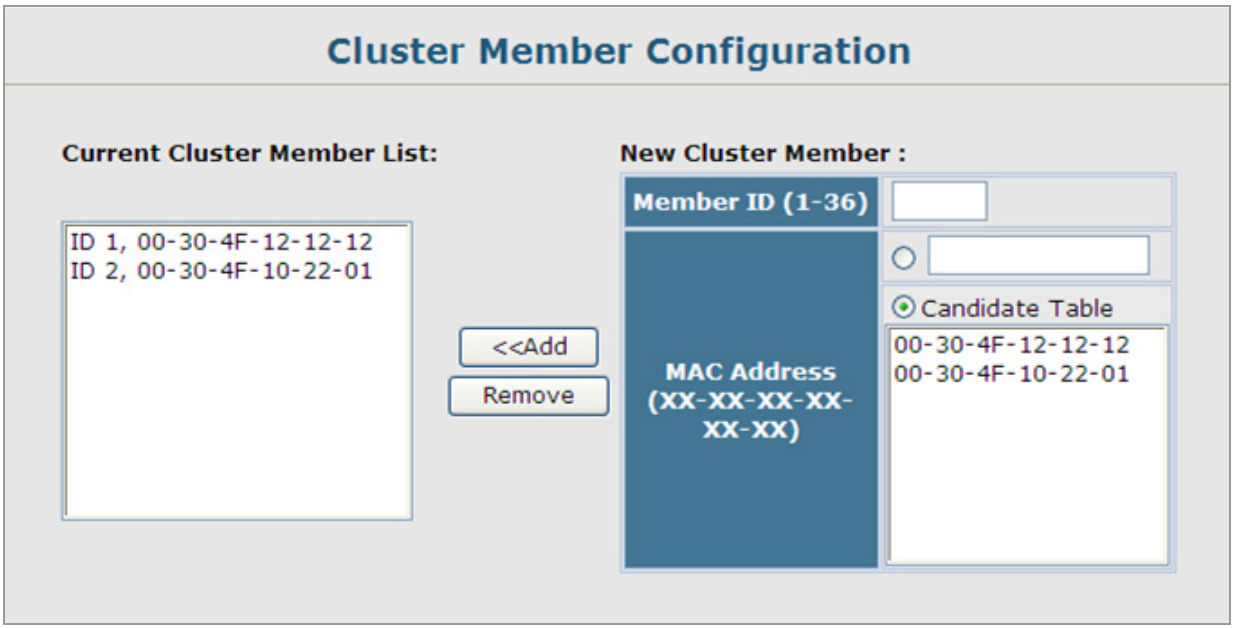


Figure 4-12-2 Cluster Member Configuration page screenshot

The page includes the following fields:

Object	Description
Member ID	Specify a Member ID number for the selected Candidate switch. (Range: 1-36)
MAC Address	Select a discoverd switch MAC address from the Candidate Table, or enter a specific MAC address of a known switch.

4.12.3 Cluster Member Information

Displays current cluster Member switch information.

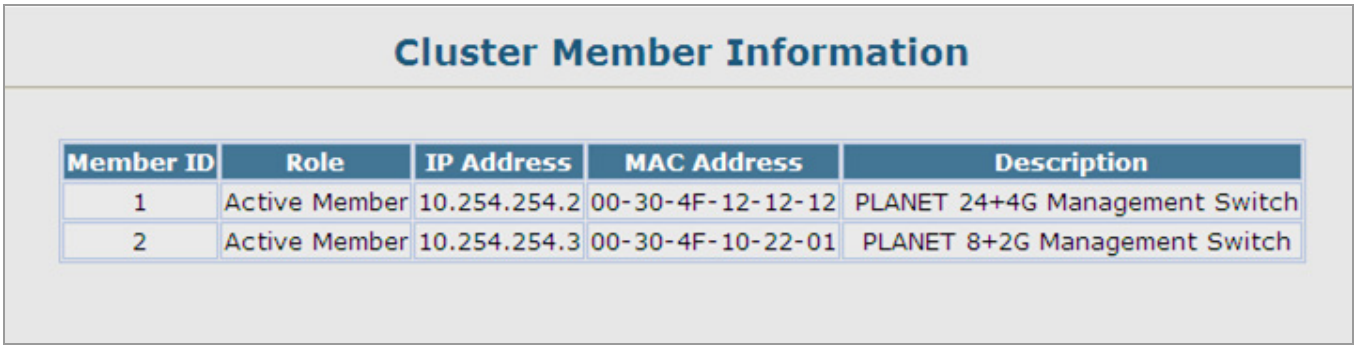


Figure 4-12-3 Cluster Member Information page screenshot

The page includes the following fields:

Object	Description
Member ID	The ID number of the Member switch. (Range: 1-36)
Role	Indicates the current status of the switch in the cluster.
IP Address	The internal cluster IP address assigned to the Member switch.
MAC Address	The MAC address of the Member switch.
Description	The system description string of the Member switch.

4.12.4 Cluster Candidate Information

Displays information about discovered switches in the network that are already cluster Members or are available to become cluster Members.

Figure 4-12-4 Cluster Candidate Information page screenshot

The page includes the following fields:

Object	Description
Role	Indicates the current status of Candidate switches in the network.
MAC Address	The MAC address of the Candidate switch.
Description	The system description string of the Candidate switch.

4.13 Power Over Ethernet (SGSD-1022P / SGSW-2840P)

Providing up to 8/24 PoE, in-line power interface, the SGSD-1022P / SGSW-2840P PoE Switch can easily build a power central-controlled IP phone system, IP Camera system, AP group for the enterprise. For instance, 8 camera / AP can be easily installed around the corner in the company for surveillance demands or build a wireless roaming environment in the office. Without the power-socket limitation, the PoE Switch makes the installation of cameras or WLAN AP more easily and efficiently.

4.13.1 Power over Ethernet Powered Device

 3~5 watts	**Voice over IP phones** Enterprise can install POE VoIP Phone, ATA and other Ethernet/non-Ethernet end-devices to the central where UPS is installed for un-interrupt power system and power control system.
 6~12 watts	**Wireless LAN Access Points** Museum, Sightseeing, Airport, Hotel, Campus, Factory, Warehouse can install the Access Point any where with no hesitation
 10~12 watts	**IP Surveillance** Enterprise, Museum, Campus, Hospital, Bank, can install IP Camera without limits of install location – no need electrician to install AC sockets.
 3~12 watts	**PoE Splitter** PoE Splitter split the PoE 48V DC over the Ethernet cable into 5/9/12V DC power output. It frees the device deployment from restrictions due to power outlet locations, which eliminate the costs for additional AC wiring and reduces the installation time.

4.13.2 Power Management:

In a power over Ethernet system, operating power is applied from a power source (PSU-power supply unit) over the LAN infrastructure to **powered devices (PDs)**, which are connected to ports. Under some conditions, the total output power required by PDs can exceed the maximum available power provided by the PSU. The system may a prior be planed with a PSU capable of supplying less power than the total potential power consumption of all the PoE ports in the system. In order to maintain the majority of ports active, power management is implemented.

The PSU input power consumption is monitored by measuring voltage and current .The input power consumption is equal to the system's aggregated power consumption .The power management concept allows all ports to be active and activates additional ports, as long as the aggregated power of the system is lower than the power level at which additional PDs cannot be connected .When this value is exceeded, ports will be deactivated, according to user-defined priorities. The power budget is managed according to the following user-definable parameters: maximum available power, ports priority, maximum allowable power per port.

This section provides PoE (Power over Ethernet) Configuration and PoE output status of PoE Switch, screen in Figure 4-13-1 appears.

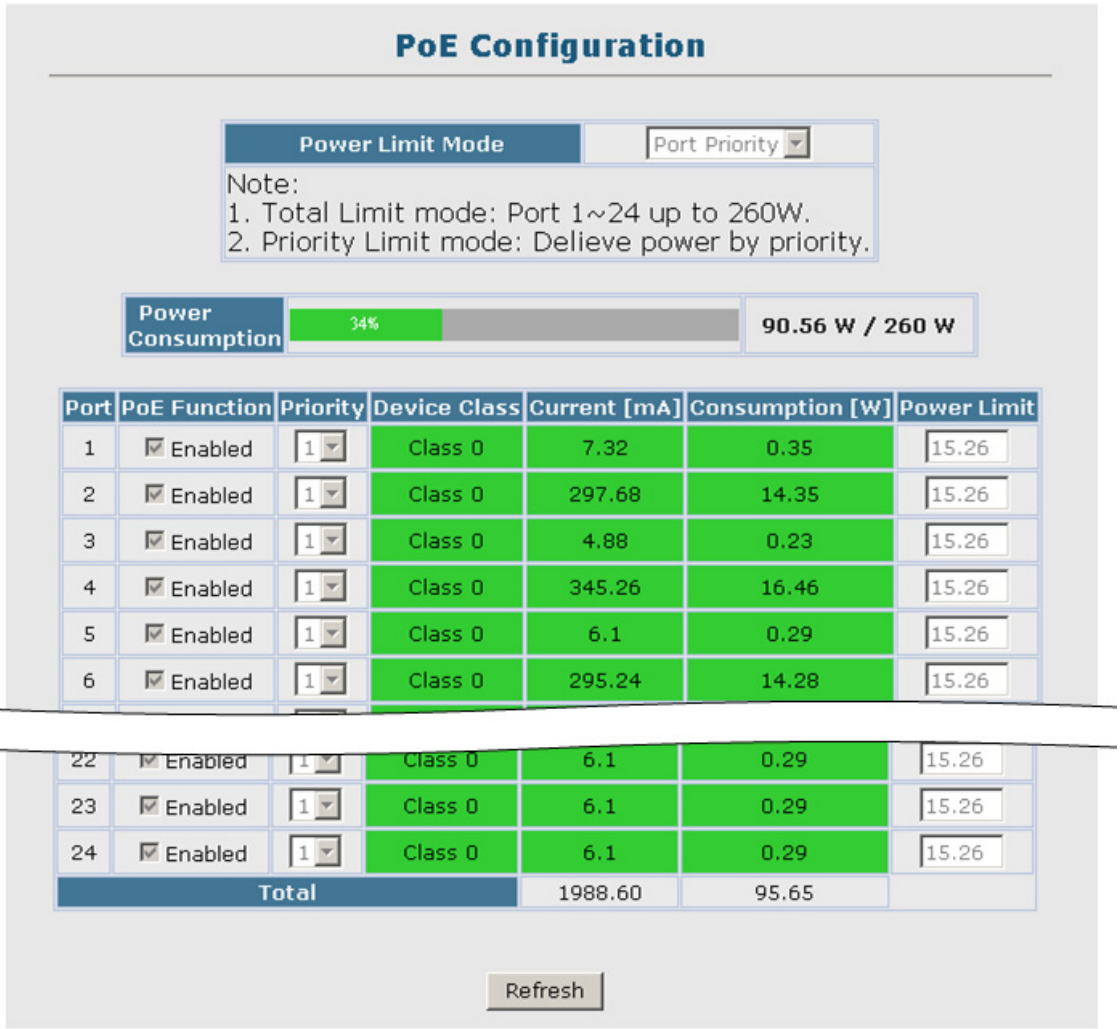

PoE Configuration
Power Limit Mode
Port Priority
Note:
1. Total Limit mode: Port 1~24 up to 260W.
2. Priority Limit mode: Delieve power by priority.
Power Consumption
34%
90.56 W / 260 W
Port PoE Function Priority Device Class Current [mA] Consumption [W] Power Limit
1 Enabled 1 Class 0 7.32 0.35 15.26
2 Enabled 1 Class 0 297.68 14.35 15.26
3 Enabled 1 Class 0 4.88 0.23 15.26
4 Enabled 1 Class 0 345.26 16.46 15.26
5 Enabled 1 Class 0 6.1 0.29 15.26
6 Enabled 1 Class 0 295.24 14.28 15.26
22 Enabled 1 Class 0 6.1 0.29 15.26
23 Enabled 1 Class 0 6.1 0.29 15.26
24 Enabled 1 Class 0 6.1 0.29 15.26
Total 1988.60 95.65
Refresh

Figure 4-13-1

The page includes the following fields:

Object	Description
Power limit mode	Allow to configure power limit mode of Web Smart Device. It can choose : ■ **Port Priority** Deliver PoE power by port priority setting ■ **Total Limit**. Set limit value of the total POE port provided power to the PDs.
Power reservation	Show the total watts usage of PoE Switch.
PoE Function	Can enable or disable the PoE function.
Priority	Set port priority for the POE power management It can choose the **"port priority"**, value is **"1~4"**. High priority is **"1"**.
Device class	Class 0 is the default for PDs. However, to improve power management at the PSE, the PD may opt to provide a signature for Class 1 to 3. The PD is classified based on power. The classification of the PD is the maximum power that the PD will draw across all input voltages and operational modes. A PD shall return Class 0 to 3 in accordance with the maximum power draw as specified by **Table 4.1**.
Current(mA)	It shows the PoE device current Amp.
Consumption [W]	It shows the PoE device current watt.
Power Limit	It can limit the port PoE supply watts. Per port maximum value must less **15.4, t**otal ports values must less than the Power Reservation value. Once power overload detected, the port will auto shut down and keep on detection mode until PD's power consumption lower than the power limit value.

For SGSW-2840P, the total PoE power reservation from Port-1~24 is up to **260W**

For SGSD-1022, the total PoE power reservation from Port-1~8 is up to **110W**

■ **PD Classifications**

A PD may be classified by the PSE based on the classification information provided by the PD. The intent of PD classification is to provide information about the maximum power required by the PD during operation. Class 0 is the default for PDs. However, to improve power management at the PSE, the PD may opt to provide a signature for Class 1 to 3.

The PD is classified based on power. The classification of the PD is the maximum power that the PD will draw across all input voltages and operational modes.

A PD shall return Class 0 to 3 in accordance with the maximum power draw as specified by Table 4-13-1.

Class	Usage	Range of maximum power used by the PD
0	Default	0.44 to 12.95 Watts
1	Optional	0.44 to 3.84 Watts
2	Optional	3.84 to 6.49 Watts
3	Optional	6.49 to 12.95 Watts
4	Not Allowed	Reserved for Future Use

Table 4.13-1 Device class

Class 4 is defined but is reserved for future use. A Class 4 signature cannot be provided by a compliant PD.

5. COMMAND LINE INTERFACE

This chapter describes how to use the Command Line Interface (CLI).

5.1 Using the Command Line Interface

5.1.1 Accessing the CLI

When accessing the management interface for the switch over a direct connection to the server's console port, or via a Telnet connection, the switch can be managed by entering command keywords and parameters at the prompt. Using the switch's command-line interface (CLI) is very similar to entering commands on a UNIX system.

5.1.2 Console Connection

To access the switch through the console port, perform these steps:

1. At the console prompt, enter the user name and password. (The default user names are "admin" and "guest" with corresponding passwords of "admin" and "guest.") When the administrator user name and password is entered, the CLI displays the "Console#" prompt and enters privileged access mode (i.e., Privileged Exec). But when the guest user name and password is entered, the CLI displays the "Console>" prompt and enters normal access mode (i.e., Normal Exec).
2. Enter the necessary commands to complete your desired tasks.
3. When finished, exit the session with the "quit" or "exit" command.

After connecting to the system through the console port, the login screen displays:

```
User Access Verification
Username: admin
Password:
        CLI session with the SGSD-1022 is opened.
        To end the CLI session, enter [Exit].
Console#
```

5.1.3 Telnet Connection

Telnet operates over the IP transport protocol. In this environment, your management station and any network device you want to manage over the network must have a valid IP address. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Each address consists of a network portion and host portion. For example, the IP address assigned to this switch, 10.1.0.1, with subnet mask 255.255.255.0, consists of a network portion (10.1.0) and a host portion (1).

The IP address for this switch is obtained via DHCP by default.

To access the switch through a Telnet session, you must first set the IP address for the switch, and set the default gateway if you are managing the switch from a different IP subnet. For example,

```
Console(config)# interface vlan 1
Console(config-if)# ip address 10.1.0.254 255.255.255.0
Console(config-if)# exit
Console(config)# ip default-gateway 10.1.0.254
```

If your corporate network is connected to another network outside your office or to the Internet, you need to apply for a registered IP address. However, if you are attached to an isolated network, then you can use any IP address that matches the network segment to which you are attached.

After you configure the switch with an IP address, you can open a Telnet session by performing these steps:

1. From the remote host, enter the Telnet command and the IP address of the device you want to access.
2. At the prompt, enter the user name and system password. The CLI will display the "Vty-n#" prompt for the administrator to show that you are using privileged access mode (i.e., Privileged Exec), or "Vty-n>" for the guest to show that you are using normal access mode (i.e., Normal Exec), where n indicates the number of the current Telnet session.
3. Enter the necessary commands to complete your desired tasks.
4. When finished, exit the session with the "quit" or "exit" command.

After entering the Telnet command, the login screen displays:

```
Username: admin
Password:
CLI session with the SGSD-1022 is opened.
To end the CLI session, enter [Exit].
Vty-0#
```

You can open up to four sessions to the device via Telnet.

5.2 Entering Commands

This section describes how to enter CLI commands.

5.2.1 Keywords and Arguments

A CLI command is a series of keywords and arguments. Keywords identify a command, and arguments specify configuration parameters. For example, in the command "show interfaces status ethernet 1/5," show interfaces and status are keywords, ethernet is an argument that specifies the interface type, and 1/5 specifies the unit/port.

You can enter commands as follows:

To enter a simple command, enter the command keyword.

To enter multiple commands, enter each command in the required order. For example, to enable Privileged Exec **Command Mode**, and display the startup configuration, enter:

```
Console>enable
Console# show startup-config
```

• To enter commands that require parameters, enter the required parameters after the command keyword. For example, to set a password for the administrator, enter:

```
Console(config)# username admin password 0 smith
```

5.2.2 Minimum Abbreviation

The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command "configure" can be entered as con. If an entry is ambiguous, the system will prompt for further input.

5.2.3 Command Completion

If you terminate input with a Tab key, the CLI will print the remaining characters of a partial keyword up to the point of ambiguity. In the "logging history" example, typing log followed by a tab will result in printing the command up to "logging."

5.2.4 Getting Help on Commands

You can display a brief description of the help system by entering the help command. You can also display command syntax by

using the "?" character to list keywords or parameters.

5.2.5 Showing Commands

If you enter a "**?**" at the command prompt, the system will display the first level of keywords for the current command class (Normal Exec or Privileged Exec) or configuration class (Global, ACL, Interface, Line or VLAN Database). You can also display a list of valid keywords for a specific command. For example, the command "**show ?**" displays a list of possible show commands:

```
Console# show ?
  access-group          Access groups
  access-list           Access lists
  accounting            Uses an accounting list with this name
  banner                Banner info
  bridge-ext            Bridge extension information
   calendar             Date and time information
  class-map             Displays class maps
  cluster               Display cluster
  dot1q-tunnel          dot1q-tunnel
  dot1x                 802.1x content
  garp                  GARP properties
  gvrp                  GVRP interface information
  history               History information
  interfaces            Interface information
  ip                    IP information
  lacp                  LACP statistics
  line                  TTY line information
  lldp                  LLDP
  log                   Login records
  logging               Logging setting
  mac                   MAC access list
  mac-address-table     Shows the MAC address table
  management            Show management information
  map                   Maps priority
  mvr                   Show mvr interface information
  network-access        Shows the entries of the secure port.
  policy-map            Displays policy maps
  port                  Port characteristics
  private-vlan          Private VLAN
```

privilege	Shows current privilege level
process	Device process
protocol-vlan	Protocol-VLAN information
public-key	Public key information
queue	Priority queue information
radius-server	RADIUS server information
running-config	Information on the running configuration
snmp	Simple Network Management Protocol statistics
sntp	Simple Network Time Protocol configuration
spanning-tree	Spanning-tree configuration
ssh	Secure shell server connections
startup-config	Startup system configuration
system	System information
tacacs-server	TACACS server settings
users	Information about terminal lines
version	System hardware and software versions
vlan	Virtual LAN settings
voice	Shows the voice VLAN information
web-auth	Shows web authentication configuration

The command "**show interfaces ?**" will display the following information:

Console# **show interfaces ?**

counters	Interface counters information
protocol-group	Protocol group
status	Interface status information
switchport	Interface switchport information

Console#show interfaces

5.2.6 Partial Keyword Lookup

If you terminate a partial keyword with a question mark, alternatives that match the initial letters are provided. (Remember not to leave a space between the command and question mark.) For example "**s?**" shows all the keywords starting with "**s**."

```
Console# show s?
snmp    sntp    spanning-tree    ssh startup-config    System
Console# show s
```

5.2.7 Negating the Effect of Commands

For many configuration commands you can enter the prefix keyword "no" to cancel the effect of a command or reset the configuration to the default value. For example, the logging command will log system messages to a host server. To disable logging, specify the no logging command. This guide describes the negation effect for all applicable commands.

5.2.8 Using Command History

The CLI maintains a history of commands that have been entered. You can scroll back through the history of commands by pressing the up arrow key. Any command displayed in the history list can be executed again, or first modified and then executed.

Using the show history command displays a longer list of recently executed commands.

5.2.9 Understanding Command Modes

The command set is divided into Exec and Configuration classes. Exec commands generally display information on system status or clear statistical counters. Configuration commands, on the other hand, modify interface parameters or enable certain switching functions. These classes are further divided into different modes. Available commands depend on the selected mode. You can always enter a question mark "?" at the prompt to display a list of the commands available for the current mode. The command classes and associated modes are displayed in the following table:

Class	**Mode**	
Exec	Normal Privileged	
Configuration	Global*	Access Control List Class Map Interface Line Multiple Spanning Tree Policy Map Server Group

		VLAN Database

Table 5-1 Command Modes

1. You must be in Privileged Exec mode to access the Global configuration mode.
2. You must be in Global Configuration mode to access any of the other configuration modes.

5.2.10 Exec Commands

When you open a new console session on the switch with the user name and password "guest," the system enters the Normal Exec command mode (or guest mode), displaying the "**Console>**" command prompt. Only a limited number of the commands are available in this mode. You can access all commands only from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a new console session with the user name and password "admin." The system will now display the "**Console#**" command prompt. You can also enter Privileged Exec mode from within Normal Exec mode, by entering the enable command, followed by the privileged level password "**super**".

To enter Privileged Exec mode, enter the following user names and passwords:

```
Username: admin
Password: [admin login password]

   CLI session with the SGSD-1022 is opened.
   To end the CLI session, enter [Exit].

Console#
```

```
Username: guest
Password: [guest login password]

   CLI session with the SGSD-1022 is opened.
   To end the CLI session, enter [Exit].
Console>enable
Password: [privileged level password]

Console#
```

5.2.11 Configuration Commands

Configuration commands are privileged level commands used to modify switch settings. These commands modify the running configuration only and are not saved when the switch is rebooted. To store the running configuration in non-volatile storage, use the **copy running-config startup-config** command.

The configuration commands are organized into different modes:

• **Global Configuration -**	These commands modify the system level configuration, and include commands such as **hostname** and **snmp-server community**.
• **Access Control List Configuration -**	These commands are used for packet filtering.
• **Class Map Configuration -**	Creates a DiffServ class map for a specified traffic type.
• **Interface Configuration -**	These commands modify the port configuration such as **speed-duplex** and **negotiation**.
• **Line Configuration -**	These commands modify the console port and Telnet configuration, and include command such as parity and data bits.
• **Multiple Spanning Tree Configuration -**	These commands configure settings for the selected multiple spanning tree instance.
• **Policy Map Configuration -**	Creates a DiffServ policy map for multiple interfaces.
• **VLAN Configuration -**	Includes the command to create VLAN groups.

To enter the Global Configuration mode, enter the command **configure** in Privileged Exec mode. The system prompt will change to "**Console(config)#**" which gives you access privilege to all Global Configuration commands.

```
Console# configure
Console(config)#
```

To enter the other modes, at the configuration prompt type one of the following commands. Use the **exit** or **end** command to return to the Privileged Exec mode.

Mode	Command	Prompt
Line	line {console | vty}	Console(config-line)#
Access Control List	access-list ip standard access-list ip extended access-list mac	Console(config-std-acl) Console(config-ext-acl) Console(config-mac-acl)
Class Map	class map	Console(config-cmap)
Interface	interface {ethernet port | port-channel id| vlan id}	Console(config-if)#
MSTP	spanning-tree mst-configuration	Console(config-mstp)#

Policy Map	policy map	Console(config-pmap)
Server Group	aaa group server radius aaa group server tacacs+	Console(config-sg-radius) Console(config-sg-tacacs+)
VLAN	vlan database	Console(config-vlan)

Table 5-2 Configuration Modes

For example, you can use the following commands to enter interface configuration mode, and then return to Privileged Exec mode

```
Console(config)# interface ethernet 1/5
Console(config-if)# exit
Console(config)#
```

5.2.12 Command Line Processing

Commands are not case sensitive. You can abbreviate commands and parameters as long as they contain enough letters to differentiate them from any other currently available commands or parameters. You can use the Tab key to complete partial commands, or enter a partial command followed by the "?" character to display a list of possible matches. You can also use the following editing keystrokes for command-line processing:

Keystroke	Function
Ctrl-A	Shifts cursor to start of command line.
Ctrl-B	Shifts cursor to the left one character.
Ctrl-C	Terminates the current task and displays the command prompt.
Ctrl-E	Shifts cursor to end of command line.
Ctrl-F	Shifts cursor to the right one character.
Ctrl-K	Deletes all characters from the cursor to the end of the line.
Ctrl-L	Repeats current command line on a new line.
Ctrl-N	Enters the next command line in the history buffer.
Ctrl-P	Enters the last command.
Ctrl-R	Repeats current command line on a new line.
Ctrl-U	Deletes from the cursor to the beginning of the line.
Ctrl-W	Deletes the last word typed.
Esc-B	Moves the cursor back one word.
Esc-D	Deletes from the cursor to the end of the word.
Esc-F	Moves the cursor forward one word.
Delete key or backspace key	Erases a mistake when entering a command.

Table 5-3 Command Line Processing

5.3 Command Groups

The system commands can be broken down into the functional groups shown below.

Command Group	Description
General	Basic commands for entering privileged access mode, restarting thesystem, or quitting the CLI
System Management	Display and setting of system information, basic modes of operation, maximum frame size, file management, console port and telnet settings, system logs, SMTP alerts, system clock, and switch clustering
Simple Network Management Protocol	Activates authentication failure traps; configures community accessstrings, and trap receivers
Authentication	Configures user names and passwords, logon access using local orremote authentication (including AAA), management access through the web server, Telnet server and Secure Shell; as well as port security, IEEE 802.1X port access control, and restricted access based on specified IP addresses
Client Security	Segregates traffic for clients attached to common data ports; and prevents unauthorized access by configuring valid static or dynamicaddresses, and filtering DHCP requests and replies
Access Control List	Provides filtering for IP frames (based on address, protocol, or TCP/UDP port number or TCP control code) or non-IP frames (based onMAC address or Ethernet type)
Interface	Configures the connection parameters for all Ethernet ports,aggregated links, and VLANs
Link Aggregation	Statically groups multiple ports into a single logical trunk; configures Link Aggregation Control Protocol for port trunks
Mirror Port	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port
Rate Limiting	Controls the maximum rate for traffic transmitted or received on a port
Address Table	Configures the address table for filtering specified addresses, displays current entries, clears the table, or sets the aging time
Spanning Tree	Configures Spanning Tree settings for the switch
VLANs	Configures VLAN settings, and defines port membership for VLAN groups; also enables or configures private VLANs, protocol VLANs,and voice VLANs
Link Layer Discovery Protocol	Configures LLDP settings to enable information discovery aboutneighbor devices
Class of Service	Sets port priority for untagged frames, selects strict priority or weightedround robin, relative weight for each priority queue, also sets priority for TCP/UDP traffic types, and DSCP

Quality of Service	Configures Differentiated Services
Multicast Filtering	Configures IGMP multicast filtering, query parameters, specifies ports attached to a multicast router, and enables multicast VLAN registration
IP Interface	Configures IP address for the switch

Table 5-4 Command Groups

The access mode shown in the following tables is indicated by these abbreviations:

ACL (Access Control List Configuration)
CM (Class Map Configuration)
GC (Global Configuration)
IC (Interface Configuration)
LC (Line Configuration)
MST (Multiple Spanning Tree)
NE (Normal Exec)
PE (Privileged Exec)
PM (Policy Map Configuration)
SG (Server Group)
VC (VLAN Database Configuration)

5.4 General Commands

These commands are used to control the command access mode, configuration mode, and other basic functions.

Command	Function	Mode
enable	Activates privileged mode	NE
disable	Returns to normal mode from privileged mode	PE
configure	Activates global configuration mode	PE
show history	Shows the command history buffer	NE, PE
reload	Restarts the system	PE
prompt	Customizes the prompt used in PE and NE mode	GC
end	Returns to Privileged Exec mode	any config. mode
exit	Returns to the previous configuration mode, or exits the CLI	any
quit	Exits a CLI session	NE, PE
help	Shows how to use help	any
?	Shows options for command completion (context sensitive)	any

Table 4-5 General Commands

enable

This command activates Privileged Exec mode. In privileged mode, additional commands are available, and certain commands display additional information. See "**Understanding Command Modes**".

Syntax

enable [level]

level - Privilege level to log into the device.

The device has two predefined privilege levels:

0: Normal Exec,

15: Privileged Exec.

Enter level 15 to access Privileged Exec mode.

Default Setting

Level 15

Command Mode

Normal Exec

Command Usage

"admin" is the default password required to change the command mode from Normal Exec to Privileged Exec.

(To set this password, see the **enable password** command.)

The "#" character is appended to the end of the prompt to indicate that the system is in privileged access mode.

Example

```
Console>enable
Password: [privileged level password]
Console#
```

Related Commands

disable

enable password

disable

This command returns to Normal Exec mode from privileged mode. In normal access mode, you can only display basic information on the switch's configuration or Ethernet statistics. To gain access to all commands, you must use the privileged mode. See "**Understanding Command Modes**".

Default Setting

None

Command Mode

Privileged Exec

Command Usage

The ">" character is appended to the end of the prompt to indicate that the system is in normal access mode.

Example

```
Console#disable
Console>
```

Related Commands

enable

configure

This command activates Global Configuration mode. You must enter this mode to modify any settings on the switch. You must also enter Global Configuration mode prior to enabling some of the other configuration modes, including Interface Configuration, Line Configuration, VLAN Database Configuration, and Multiple Spanning Tree Configuration. See "**Understanding Command Modes**".

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#configure
Console(config)
```

Related Commands

end

show history

This command shows the contents of the command history buffer.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The history buffer size is fixed at 10 Execution commands and 10 Configuration commands.

Example

In this example, the show history command lists the contents of the command history buffer:

```
Console# show history
Execution command history:
 2 config
```

```
 1 show history

Configuration command history:
 4 interface vlan 1
 3 exit
 2 interface vlan 1
 1 end

Console#
```

The ! command repeats commands from the Execution command history buffer when you are in Normal Exec or Privileged Exec Mode, and commands from the Configuration command history buffer when you are in any of the configuration modes. In this example, the !2 command repeats the second command in the Execution history buffer (**config**).

```
Console#!2
Console#config
Console(config)#
```

reload

This command restarts the system.

When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the copy running-config startup-config command.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

This command resets the entire system.

Example

This example shows how to reset the switch:

```
Console# reload
```

```
System will be restarted, continue <y/n>? y
```

prompt

This command customizes the CLI prompt. Use the no form to restore the default prompt.

Syntax

prompt string no prompt string - Any alphanumeric string to use for the CLI prompt. (Maximum length: 255 characters)

Default Setting

Console Command Mode Global Configuration

Example

```
Console(config)#prompt RD2
RD2(config)#
```

end

This command returns to Privileged Exec mode.

Default Setting

None

Command Mode

Global Configuration, Interface Configuration, Line Configuration, and VLAN Database Configuration.

Example

This example shows how to return to the Privileged Exec mode from the Interface Configuration mode:

```
Console(config-if)# end
Console#
```

exit

This command returns to the previous configuration mode or exit the configuration program.

Default Setting

None

Command Mode

Any

Example

This example shows how to return to the Privileged Exec mode from the Global Configuration mode, and then quit the CLI

session:

```
Console(config)# exit
Console#exit

Press ENTER to start session
User Access Verification

Username:
```

quit

This command exits the configuration program.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The quit and exit commands can both exit the configuration program.

Example

This example shows how to quit a CLI session:

```
Console# quit
    Press ENTER to start session
    User Access Verification
Username:
```

5.5 System Management Commands

These commands are used to control system logs, passwords, user names, browser configuration options, and display or configure a variety of other system information.

Command Group	Function
Device Designation	Configures information that uniquely identifies this switch
Banner Information	Configures administrative contact, device identification and location
System Status	Displays system configuration, active managers, and version information
Frame Size	Enables support for jumbo frames
File Management	Manages code image or switch configuration files
Line	Sets communication parameters for the serial port, including baud rate and console time-out
Event Logging	Controls logging of error messages
SMTP Alerts	Configures SMTP email alerts
Time (System Clock)	Sets the system clock automatically via SNTP server or manually
Switch Clustering	Configures management of multiple devices via a single IP address

Table 5-6 System Management Commands

5.5.1 Device Designation Commands

Command	Function	Mode
hostname	Specifies the host name for the switch	GC
snmp-server contact	Sets the system contact string	GC
snmp-server location	Sets the system location string	GC

Table 5-7 Device Designation Commands

hostname

This command specifies or modifies the host name for this device. Use the no form to restore the default host name.

Syntax

hostname name no hostname name - The name of this host. (Maximum length: 255 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#hostname RD#1
```

```
Console(config)#
```

5.5.2 Banner Information Commands

These commands are used to configure and manage administrative information about the switch, its exact data center location, details of the electrical and network circuits that supply the switch, as well as contact information for the network administrator and system manager. This information is only available via the CLI and is automatically displayed before login as soon as a console or telnet connection has been established.

Command	Function	Mode
banner configure	Configures banner information displayed before login	GC
banner configure company	Configures Company information displayed by the banner	GC
banner configuredc-powerinfo	Configures DC Power information displayed by the banner	GC
banner configuredepartment	Configures Department information displayed by the banner	GC
banner configureequipment-info	Configures Equipment information displayed by the banner	GC
banner configureequipment-location	Configures Equipment Location information displayed by thebanner	GC
banner configureip-lan	Configures IP and LAN information displayed by the banner	GC
banner configurelp-number	Configures LP Number information displayed by the banner	GC
banner configure manager-info	Configures Manager contact information displayed by thebanner	GC
banner configure mux	Configures MUX information displayed by the banner	GC
banner configure note	Configures miscellaneous information displayed by the banner under the Notes heading	GC
show banner	Displays all banner information	NE, PE

Table 5-8 Banner Commands

banner configure

This command is used to interactively specify administrative information for this device.

Syntax

banner configure

Default Setting

None

Command Mode

Global Configuration

Command Usage

The administrator can batch-input all details for the switch with one command. When the administrator finishes typing the

company name and presses the enter key, the script prompts for the next piece of information, and so on, until all information has been entered. Pressing enter without inputting information at any prompt during the script's operation will leave the field empty. Spaces can be used during script mode because pressing the enter key signifies the end of data input. The delete and left-arrow keys terminate the script. Use of the backspace key during script mode is not supported. If, for example, a mistake is made in the company name, it can be corrected with the banner configure company command.

Example

```
Console(config)#banner configure

Company: ABC Co.
Responsible department: R&D Dept
Name and telephone to Contact the management people
Manager1 name: Sr. Network Admin
  phone number: 123-555-1212
Manager2 name: Jr. Network Admin
  phone number: 123-555-1213
Manager3 name: Night-shift Net Admin / Janitor
  phone number: 123-555-1214
The physical location of the equipment.
City and street address: 12 Straight St. Motown, Zimbabwe
Information about this equipment:
Manufacturer: ABC Co.
ID: 123_unique_id_number
Floor: 2
Row: 7
Rack: 29
Shelf in this rack: 8
Information about DC power supply.

Floor: 2
Row: 7
Rack: 25
Electrical circuit: : ec-177743209-xb
Number of LP:12
Position of the equipment in the MUX:1/23
IP LAN:192.168.1.1
Note: This is a random note about this managed switch and can contain
miscellaneous information.
Console(config)#
```

banner configure company

This command is used to configure company information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure company name

no banner configure company

name - The name of the company. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The **banner configure company** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)#banner configure company ABC Co.
Console(config)#
```

banner configure dc-power-info

This command is use to configure DC power information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure dc-power-info floor floor-id row row-id rack rack-id electrical-circuit ec-id no banner configure dc-power-info [floor | row | rack | electrical-circuit]

floor-id - The floor number.

row-id - The row number.

rack-id - The rack number.

ec-id - The electrical circuit ID.

Default Setting

None

Command Mode

Global Configuration

Command Usage

Maximum string length for each command attribute is 32 characters.

Input strings cannot contain spaces. The banner configure dc-power-info command interprets spaces as data input boundaries.

The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)#banner configure floor 3 row 15 rack 24
electrical-circuit 48v-id_3.15.24.2

Console(config)#
```

banner configure department

This command is used to configure the department information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure department dept-name no banner configure company dept-name -The name of the department. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The banner configure department command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)#banner configure department R&D
Console(config)#
```

banner configure equipment-info

This command is used to configure the equipment information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure equipment-info manufacturer-id mfr-id floor floor-id row row-id rack rack-id shelf-rack sr-id manufacturer mfr-name no banner configure equipment-info [floor | manufacturer | manufacturer-id | rack | row | shelf-rack]

mfr-id -The name of the device model number.

floor-id - The floor number.

row-id - The row number.

rack-id - The rack number.

sr-id -The shelf number in the rack.

mfr-name -The name of the device manufacturer.

Default Setting

None

Command Mode

Global Configuration

Command Usage

Maximum string length for each command attribute is 32 characters.

Input strings cannot contain spaces. The banner configure equipment-info command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure equipment-info manufacturer-id switch35 floor 3 row 10 rack 15 shelf-rack 12 manufacturer ABC Co.
Console(config)#
```

banner configure equipment-location

This command is used to configure the equipment location information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure equipment-location location no banner configure equipment-location location -The address location of the device. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The banner configure equipment-location command interprets spaces as data input

boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure equipment-location 710_Network_Path,_Indianapolis

Console(config)#
```

banner configure ip-lan

This command is used to configure the device IP address and subnet mask information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure ip-lan ip-mask no banner configure ip-lan ip-mask

-The IP address and subnet mask of the device.

(Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Inpu strings cannot contain spaces. The banner configure ip-lan command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure ip-lan 192.168.1.1/255.255.255.0
Console(config)#
```

banner configure lp-number

This command is used to configure the LP number information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure lp-number lp-num no banner configure lp-number

lp-num - The LP number. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The banner configure lp-number command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure lp-number 12
Console(config)#
```

banner configure manager-info

This command is used to configure the manager contact information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure manager-info name mgr1-name phone-number mgr1-number [name2 mgr2-name phone-number mgr2-number | name3 mgr3-name phone-number mgr3-number] no banner configure manager-info [name1 | name2 | name3]

mgr1-name -The name of the first manager.

mgr1-number -The phone number of the first manager.

mgr2-name -The name of the second manager.

mgr2-number -The phone number of the second manager.

mgr3-name -The name of the third manager.

mgr3-number -The phone number of the third manager.

Default Setting

None

Command Mode

Global Configuration

Command Usage

Maximum string length for each command attribute is 32 characters. Input strings cannot contain spaces.

The banner configure manager-info command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure manager-info name Albert_Einstein phone-number
123-555-1212 name2 Lamar phone-number 123-555-1219
Console(config)#
```

banner configure mux

This command is used to configure the mux information displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure mux muxinfo no banner configure mux muxinfo -

The circuit and PVC to which the switch is connected. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The banner configure mux command interprets spaces as data input boundaries.

The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure mux telco-8734212kx_PVC-1/23
Console(config)#
```

banner configure note

This command is used to configure the note displayed in the banner. Use the no form to restore the default setting.

Syntax

banner configure note note-info no banner configure note note-info -

Miscellaneous information that does not fit in the other banner categories, or any other information of importance to users of the switch CLI. (Maximum length: 150 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The banner configure note command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where whitespace is necessary for clarity.

Example

```
Console(config)# banner configure note !!!!!ROUTINE_MAINTENANCE_firmware
upgrade_0100-0500_GMT-0500_20071022!!!!!_20min_network_impact_expected
Console(config)#
```

show banner

This command displays all banner information.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console# show banner

ABC Co.
WARNING - MONITORED ACTIONS AND ACCESSES
R&D_Dept

Albert_Einstein - 123-555-1212
Steve - 123-555-9876
Lamar - 123-555-3322

Station's information:
710_Network_Path,Indianapolis

ABC Co.- switch35 Floor / Row / Rack / Sub-Rack 7 / 10 / 15 / 6 DC power supply: Power Source A:
Floor / Row / Rack / Electrical circuit 3 / 15 / 24 / 48V-id_3.15.24.2
 Number of LP: 4
 Position MUX: telco-9734212kx_PVC-1/23
 IP LAN: 216.241.132.3/255.255.255.0
 Note:
 !!!!!ROUTINE_MAINTENANCE_firmware-upgrade_0100--0500_GMT-0500_20071022!!!
 !!_20min_network_impact_expected
 Console#
```

5.5.3 System Status Commands

This section describes commands used to display system information.

Command	Function	Mode
show startup-config	Displays the contents of the configuration file (stored in flashmemory) that is used to start up the system	PE
show running-config	Displays the configuration data currently in use	PE
show system	Displays system information	NE, PE
show users	Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet clients	NE, PE
show version	Displays version information for the system	NE, PE

Table 5-9 System Status Commands

show startup-config

This command displays the configuration file stored in non-volatile memory that is used to start up the system.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Use this command in conjunction with the show running-config command to compare the information in running memory to the information stored in non-volatile memory.

This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:

-Switch's MAC address

-SNTP server settings

-Broadcast storm control settings

-SNMP community strings

-Users (names and access levels)

-Event log settings

-VLAN database (VLAN ID, name and state)

-VLAN configuration settings for each interface

-Multiple spanning tree instances (name and interfaces)

-IP address configured for the switch

-Spanning tree settings

-Interface settings

-Any configured settings for the console port and Telnet

Example

```
Console# show startup-config

building startup-config, please wait.....

!<stackingDB>00</stackingDB>

!<stackingMac>01_00-30-4f-10-22-bc_01</stackingMac>

!

phymap 00-30-4f-10-22-bc

!

SNTP server 0.0.0.0 0.0.0.0 0.0.0.0

!

broadcast byte-rate 1000 level 5

!

snmp-server community public ro

snmp-server community private rw

!

username admin access-level 15

username admin password 7 21232f297a57a5a743894a0e4a801fc3

username guest access-level 0

username guest password 7 084e0343a0486ff05530df6c705c8bb4

enable password level 15 7 1b3231655cebb7a1f783eddf27d254ca

!

snmp-server community public ro

snmp-server community private rw

!

no logging trap

!

vlan database
  vlan 1 name DefaultVlan media ethernet state active
  VLAN 4093 media ethernet state active
```

```
!

spanning-tree MST configuration

!

interface ethernet 1/1
  switchport allowed vlan add 1 untagged
  switchport native vlan 1
  switchport allowed vlan add 4093 tagged

..
interface vlan 1
  ip address DHCP

!

line console

!

line vty

!

end

Console#
```

Related Commands

show running-config

show running-config

This command displays the configuration information currently in use.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Use this command in conjunction with the show startup-config command to compare the information in running memory to the information stored in non-volatile memory.

This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:

-Switch's MAC address

-SNTP server settings

-Broadcast storm control settings

-802.1Q tunnel settings

-SNMP community strings

-Users (names, access levels, and encrypted passwords)

-Event log settings

-VLAN database (VLAN ID, name and state)

-VLAN configuration settings for each interface

-Spanning tree settings

-Interface settings

-IP address configured for the switch

-Any configured settings for the console port and Telnet

System Management Commands

Example

```
Console# show running-config
building startup-config, please wait.....
!<stackingDB>00</stackingDB>
!<stackingMac>01_00-30-4f-10-22-bc_01</stackingMac>
!
phymap 00-30-4f-10-22
!
SNTP server 0.0.0.0 0.0.0.0 0.0.0.0
!
broadcast byte-rate 1000 level 5
!
no dot1q-tunnel system-tunnel-control
!
SNMP-server community public ro
SNMP-server community private rw
!
username admin access-level 15
username admin password 7 21232f297a57a5a743894a0e4a801fc3
username guest access-level 0
username guest password 7 084e0343a0486ff05530df6c705c8bb4
enable password level 15 7 1b3231655cebb7a1f783eddf27d254ca
!
no logging trap
!
vlan database
```

```
 vlan 1 name DefaultVlan media ethernet state active

 VLAN 4093 media ethernet state active
!
spanning-tree MST configuration
!
interface ethernet 1/1

 switchport allowed vlan add 1 untagged
 switchport native vlan 1
 switchport allowed vlan add 4093 tagged

interface VLAN 1

 IP address DHCP
!
line console
!
line vty
!
end

Console#
```

Related Commands

show startup-config

show system

This command displays system information.

Command Mode

Normal Exec, Privileged Exec

Command Usage

For a description of the items shown by this command, refer to "Displaying System Information" on page 3-12.

The POST results should all display "PASS." If any POST test indicates "FAIL," contact your distributor for assistance.

Example

```
Console# show system

System Description: PLANET 8+2G Managed Switch SGSD-1022
System OID String: 1.3.6.1.4.1.10456.1.1482
System Information
  System Up Time:            0 days, 0 hours, 57 minutes, and 56.69 seconds
  System Name:               R&D 5
  System Location:           WC 9
  System Contact:            Ted
  MAC Address (Unit1):       00-30-4F-10-22-40
  Web Server:                Enabled
  Web Server Port:           80
  Web Secure Server:         Enabled
  Web Secure Server Port:    443
  Telnet Server:             Enable
  Telnet Server Port:        23
  Jumbo Frame:               Disabled

  POST Result:
DUMMY Test 1 .....PASS
UART Loopback Test ..... PASS
DRAM Test ..... ……PASS
Switch Int Loopback Test ..... PASS

Done All Pass.
Console#
```

show users

Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet client.

Command Mode

Normal Exec, Privileged Exec

Command Usage

The session used to execute this command is indicated by a "*" symbol next to the Line (i.e., session) index number.

System Management Commands

Example

```
Console# show users


 Username accounts:
   Username Privilege Public-Key
   -------- --------- ---------
```

```
admin 15 None
guest 0 None
steve 15 RSA

 Online users:
  Line    Username Idle time (h:m:s) Remote IP addr.
  ----------- -------- ----------------- --------------

      0     console     admin       0:14:14
      *
      1     VTY 0       admin       0:00:00       192.168.1.19

      2     SSH 1       steve       0:00:06       192.168.1.19

 Web online users:
  Line    Remote IP addr Username Idle time (h:m:s).
  ----------- -------------- -------- -----------------

1 HTTP 192.168.1.19    admin 0:00:00

Console#
```

show version

This command displays hardware and software version information for the system.

Command Mode

Normal Exec, Privileged Exec

Command Usage

See "Displaying Switch Hardware/Software Versions" on page 3-14 for detailed information on the items displayed by this command.

Example

```
Console#show version
 Serial Number:            0012CF422DC0
 Service Tag:
 Hardware Version:         R0B
 EPLD Version:              0.00
 Number of Ports:          28
```

```
Main Power Status:       Up
Loader Version:          1.0.0.2
Boot ROM Version:        0.0.1.1
Operation Code Version:  0.0.3.5

Console#
```

5.5.4 Frame Size Commands

This section describes commands used to configure the Ethernet frame size on the switch.

Command	Function	Mode
jumbo frame	Enables support for jumbo frames	GC

Table 5-10 Frame Size Commands

jumbo frame

This command enables support for jumbo frames. Use the no form to disable it.

Syntax

[no] jumbo frame

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

This switch provides more efficient throughput for large sequential data transfers by supporting jumbo frames up to 9216 bytes. Compared to standard Ethernet frames that run only up to 1.5 KB, using jumbo frames significantly reduces the per-packet overhead required to process protocol encapsulation fields.

T To use jumbo frames, both the source and destination end nodes (such as a computer or server) must support this feature. Also, when the connection is operating at full duplex, all switches in the network between the two end nodes must be able to accept the extended frame size. And for half-duplex connections, all devices in the collision domain would need to support jumbo frames.

Enabling jumbo frames will limit the maximum threshold for broadcast storm control to 64 packets per second. (See the switchport broadcast command on page 4-178.)

The current setting for jumbo frames can be displayed with the show system command (page 4-30).

Example

```
Console(config)#jumbo frame
Console(config)#
```

5.5.5 File Management Commands

Managing Firmware

Firmware can be uploaded and downloaded to or from a TFTP server. By saving runtime code to a file on a TFTP server, that file can later be downloaded to the switch to restore operation. The switch can also be set to use new firmware without overwriting the previous version.

When downloading runtime code, the destination file name can be specified to replace the current image, or the file can be first downloaded using a different name from the current runtime code file, and then the new file set as the startup file.

Saving or Restoring Configuration Settings

Configuration settings can be uploaded and downloaded to and from a TFTP server. The configuration file can be later downloaded to restore switch settings.

The configuration file can be downloaded under a new file name and then set as the startup file, or the current startup configuration file can be specified as the destination file to directly replace it. Note that the file "Factory_Default_Config.cfg" can be copied to the TFTP server, but cannot be used as the destination on the switch.

Command	Function	Mode
copy	Copies a code image or a switch configuration to or from flash memory or a TFTP server	PE
delete	Deletes a file or code image	PE
dir	Displays a list of files in flash memory	PE
whichboot	Displays the files booted	PE
boot system	Specifies the file or image used to start up the system	GC

Table 5-11 Flash/File Commands

copy

This command moves (upload/download) a code image or configuration file between the switch's flash memory and a TFTP server. When you save the system code or configuration settings to a file on a TFTP server, that file can later be downloaded to the switch to restore system operation. The success of the file transfer depends on the accessibility of the TFTP server and the quality of the network connection.

Syntax

copy file {file | running-config | startup-config | tftp} copy running-config {file | startup-config | tftp} copy startup-config {file | running-config | tftp} copy tftp {file | running-config | startup-config | https-certificate | public-key}

file - Keyword that allows you to copy to/from a file.

running-config -Keyword that allows you to copy to/from the current running configuration.

startup-config - The configuration used for system initialization.

tftp - Keyword that allows you to copy to/from a TFTP server.

https-certificate - Copies an HTTPS certificate from an TFTP server to the switch.

public-key - Keyword that allows you to copy a SSH key from a TFTP server. ("Secure Shell Commands" on page 4-109)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

The system prompts for data required to complete the copy command.

The destination file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

Due to the size limit of the flash memory, the switch supports only two operation code files.

The maximum number of user-defined configuration files depends on available memory.

You can use "Factory_Default_Config.cfg" as the source to copy from the factory default configuration file, but you cannot use it as the destination.

To replace the startup configuration, you must use startup-config as the destination.

The Boot ROM and Loader cannot be uploaded or downloaded from the TFTP server. You must follow the instructions in the release notes for new firmware, or contact your distributor for help.

For information on specifying an https-certificate, see "Replacing the Default Secure-site Certificate" on page 3-74. For information on configuring the switch to use HTTPS/SSL for a secure connection, see "ip http secure-server" on page 4-106.

Example

The following Example shows how to download new firmware from a TFTP server:

```
Console#copy tftp file
TFTP server ip address: 10.1.0.19
Choose file type:

 1. config:    2. opcode: <1-2>: 2 Source file name: SGSD-1022_V1.0.0.5.bix Destination file
name: SGSD-1022_V1.0.0.5.bix \Write to FLASH Programming. -Write to FLASH finish. Success.
Console#
The following example shows how to upload the configuration settings to a file on the TFTP
```

```
server:
Console#copy file tftp
Choose file type:

 1. config:   2. opcode: <1-2>: 1
Source file name: startup
TFTP server ip address: 10.1.0.99
Destination file name: startup.01
TFTP completed.
Success.
Console#

The following example shows how to copy the running configuration to a startup file.
Console#copy running-config file
destination file name: startup
Write to FLASH Programming.
\Write to FLASH finish.
Success.

Console#

The following example shows how to download a configuration file:
Console#copy tftp startup-config
TFTP server ip address: 10.1.0.99
Source configuration file name: startup.01
Startup configuration file name [startup]:
Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#

This example shows how to copy a secure-site certificate from an TFTP server. It then reboots the
switch to activate the certificate:
Console#copy tftp https-certificate
TFTP server ip address: 10.1.0.19
Source certificate file name: SS-certificate
Source private file name: SS-private
```

```
Private password: ********

Success.
Console#reload
System will be restarted, continue <y/n>? y

This example shows how to copy a public-key used by SSH from a TFTP server. Note that public
key authentication via SSH is only supported for users configured locally on the switch:
Console#copy tftp public-key
TFTP server IP address: 192.168.1.19
Choose public key type:

 1. RSA:  2. DSA: <1-2>: 1
Source file name: steve.pub
Username: steve
TFTP Download
Success.
Write to FLASH Programming.
Success.

Console#
```

delete

This command deletes a file or image.

Syntax

delete filename filename -Name of the configuration file or image name.

Command Mode

Privileged Exec

Command Usage

If the file type is used for system startup, then this file cannot be deleted.

"Factory_Default_Config.cfg" cannot be deleted.

Example

This example shows how to delete the test2.cfg configuration file from flash memory for unit 1.

```
Console#delete 1:test2.cfg
```

```
Console#
```

Related Commands

dir

delete public-key

dir

This command displays a list of files in flash memory.

Syntax

dir {{boot-rom: | config: | opcode:} [:filename]}

The type of file or image to display includes:

boot-rom - Boot ROM (or diagnostic) image file.

config -Switch configuration file. opcode - Run-time operation code image file.

filename -Name of the configuration file or code image.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

If you enter the command dir without any parameters, the system displays all files.

File information is shown below:

Command Group	Description
file name	The name of the file.
file type	File types: Boot-Rom, Operation Code, and Config file.
startup	Shows if this file is used when the system is started.
size	The length of the file in bytes.

Table 5-12 File Directory Information

Example

The following example shows how to display all file information:

```
Console#dir File name File type Startup Size (byte) ----------------------------------- ----------
----------Unit1: SGSD-1022_DIAG_V0011.bix Boot-Rom Image Y 305424
SGSD-1022_RUNTIME_V0035_m.bix Operation Code Y 3018936
Factory_Default_Config.cfg Config File N 490 startup1.cfg Config File Y 4648
```

```
--------------------------------------------------------------------------
                        Total free space:    3276800
Console#
```

whichboot

This command displays which files were booted when the system powered up.

Command Mode

Privileged Exec

Example

This example shows the information displayed by the whichboot command. See the table under the dir command for a description of the file information displayed by this command.

```
Console#whichboot
                        File name    File type Startup Size (byte) -> align?
 -------------------------------- -------------- ------- ----------
 Unit1:
                SGSD-1022_DIAG_V0011.bix          Boot-Rom Image      Y     305424
                SGSD-1022_RUNTIME_V0035_m.bix     Operation Code      Y     3018936
                 startup1.cfg                     Config File         Y     4648
Console#
```

boot system

This command specifies the image used to start up the system.

Syntax

boot system {boot-rom| config | opcode}: filename

The type of file or image to set as a default includes:

boot-rom* - Boot ROM.

config* - Configuration file.

opcode* - Run-time operation code.

filename -Name of the configuration file or code image.

* The colon (:) is required.

Default Setting

None

Command Mode

Global Configuration

Command Usage

A colon (:) is required after the specified unit number and file type.

If the file contains an error, it cannot be set as the default file.

Example

```
Console(config)#boot system config: startup
Console(config)#
```

Related Commands

dir

whichboot

5.6 Line Commands

You can access the onboard configuration program by attaching a VT100 compatible device to the server's serial port. These commands are used to set communication parameters for the serial port or Telnet (i.e., a virtual terminal).

Command	Function	Mode
line	Identifies a specific line for configuration and starts the lineconfiguration mode	GC
login	Enables password checking at login	LC
password	Specifies a password on a line	LC
timeout login response	Sets the interval that the system waits for a user to log into the CLI	LC
exec-timeout	Sets the interval that the command interpreter waits until userinput is detected	LC
password-thresh	Sets the password intrusion threshold, which limits the number of failed logon attempts	LC
silent-time*	Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attemptsexceeds the threshold set by the password-thresh command	LC
databits*	Sets the number of data bits per character that are interpreted and generated by hardware	LC
parity*	Defines the generation of a parity bit	LC

speed*	Sets the terminal baud rate	LC
stopbits*	Sets the number of the stop bits transmitted per byte	LC
disconnect	Terminates a line connection	PE
show line	Displays a terminal line's parameters	NE, PE

Table 5-13 Line Commands

* These commands only apply to the serial port.

line

This command identifies a specific line for configuration, and to process subsequent line configuration commands.

Syntax

line {console | vty}

console -Console terminal line.

vty - Virtual terminal for remote console access (i.e., Telnet).

Default Setting

There is no default line.

Command Mode

Global Configuration

Command Usage

Telnet is considered a virtual terminal connection and will be shown as "VTY" in screen displays such as show users.

However, the serial communication parameters (e.g., databits) do not affect Telnet or SSH connections.

Example

To enter console line mode, enter the following command:

```
Console(config)#line console
Console(config-line)#
```

Related Commands

show line

show users

login

This command enables password checking at login. Use the no form to disable password checking and allow connections without a password.

Syntax

login [local] no login

local -Selects local password checking. Authentication is based on the user name specified with the username command.

Default Setting

login local

Command Mode

Line Configuration

Command Usage

There are three authentication modes provided by the switch itself at login: -login selects authentication by a single global password as specified by the password line configuration command. When using this method, the management interface starts in Normal Exec (NE) mode. -login local selects authentication via the user name and password specified by the username command (i.e., default setting). When using this method, the management interface starts in Normal Exec (NE) or Privileged Exec (PE) mode, depending on the user's privilege level (0 or 15 respectively).

no login selects no authentication. When using this method, the management interface starts in Normal Exec (NE) mode.

This command controls login authentication via the switch itself. To configure user names and passwords for remote authentication servers, you must use the RADIUS or TACACS software installed on those servers.

Example

```
Console(config-line)#login local
Console(config-line)#
```

Related Commands

username

password

password

This command specifies the password for a line. Use the no form to remove the password.

Syntax

password {0 | 7} password

no password

{0 | 7} - 0 means plain password, 7 means encrypted password

password - Character string that specifies the line password. (Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

Default Setting

No password is specified.

Command Mode

Line Configuration

Command Usage

When a connection is started on a line with password protection, the system prompts for the password. If you enter the correct password, the system shows a prompt. You can use the password-thresh command to set the number of times a

user can enter an incorrect password before the system terminates the line connection and returns the terminal to the idle state.

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

```
Console(config-line)#password 0 secret
Console(config-line)#
```

Related Commands

login

password-thresh

timeout login response

This command sets the interval that the system waits for a user to log into the CLI. Use the no form to restore the default.

Syntax

timeout login response [seconds] no timeout login response

seconds - Integer that specifies the timeout interval.

(Range: 0 -300 seconds; 0: disabled)

Default Setting

CLI: Disabled (0 seconds)

Telnet: 600 seconds

Command Mode

Line Configuration

Command Usage

If a login attempt is not detected within the timeout interval, the connection is terminated for the session.

This command applies to both the local console and Telnet connections.

The timeout for Telnet cannot be disabled.

Using the command without specifying a timeout restores the default setting.

Example

To set the timeout to two minutes, enter this command:

```
Console(config-line)#timeout login response 120
Console(config-line)#
```

Related Commands

silent-time

exec-timeout

exec-timeout

This command sets the interval that the system waits until user input is detected. Use the no form to restore the default.

Syntax

exec-timeout [seconds] no exec-timeout

seconds - Integer that specifies the number of seconds.

(Range: 0-65535 seconds; 0: no timeout)

Default Setting

CLI: No timeout

Telnet: 10 minutes

Command Mode

Line Configuration

Command Usage

If user input is detected within the timeout interval, the session is kept open; otherwise the session is terminated.

This command applies to both the local console and Telnet connections.

The timeout for Telnet cannot be disabled.

Using the command without specifying a timeout restores the default setting.

Example

To set the timeout to two minutes, enter this command:

```
Console(config-line)#exec-timeout 120
Console(config-line)#
```

Related Commands

silent-time

timeout login response

password-thresh

This command sets the password intrusion threshold which limits the number of failed logon attempts. Use the no form to remove the threshold value.

Syntax

password-thresh [threshold]

no password-thresh

threshold - The number of allowed password attempts.

(Range: 1-120; 0: no threshold)

Default Setting

The default value is three attempts.

Command Mode

Line Configuration

Command Usage

When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time before allowing the next logon attempt. (Use the silent-time command to set this interval.) When this threshold is reached for Telnet, the Telnet logon interface shuts down.

This command applies to both the local console and Telnet connections.

Example

To set the password threshold to five attempts, enter this command:

```
Console(config-line)#password-thresh 5
Console(config-line)#
```

Related Commands

silent-time

timeout login response

silent-time

This command sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the password-thresh command. Use the no form to remove the silent time value.

Syntax

silent-time [seconds]

no silent-time

seconds -The number of seconds to disable console response.

(Range: 0-65535; 0: no silent-time)

Default Setting

The default value is no silent-time.

Command Mode

Line Configuration

Example

To set the silent time to 60 seconds, enter this command:

```
Console(config-line)#silent-time 60
Console(config-line)#
```

Related Commands

password-thresh

databits

This command sets the number of data bits per character that are interpreted and generated by the console port. Use the no

form to restore the default value.

Syntax

databits {7 | 8} no databits

7 - Seven data bits per character.

8 - Eight data bits per character.

Default Setting

8 data bits per character

Command Mode

Line Configuration

Command Usage

The databits command can be used to mask the high bit on input from devices that generate 7 data bits with parity. If parity is being generated, specify 7 data bits per character. If no parity is required, specify 8 data bits per character.

Example

To specify 7 data bits, enter this command:

```
Console(config-line)#databits 7
Console(config-line)#
```

Related Commands

parity

parity

This command defines the generation of a parity bit. Use the no form to restore the default setting.

Syntax

parity {none | even | odd}

no parity

none - No parity

even - Even parity

odd - Odd parit

Default Setting

No parity

Command Mode

Line Configuration

Command Usage

Communication protocols provided by devices such as terminals and modems often require a specific parity bit setting.

Example

To specify no parity, enter this command:

```
Console(config-line)#parity none
```

```
Console(config-line)#
```

speed

This command sets the terminal line's baud rate. This command sets both the transmit (to terminal) and receive (from terminal) speeds. Use the no form to restore the default setting.

Syntax

speed bps no speed

bps - Baud rate in bits per second.

(Options: 9600, 19200, 38400 bps)

Default Setting

9600

Command Mode

Line Configuration

Command Usage

Set the speed to match the baud rate of the device connected to the serial port. Some baud rates available on devices connected to the port might not be supported. The system indicates if the speed you selected is not supported.

Example

To specify 57600 bps, enter this command:

```
Console(config-line)#speed 19200
Console(config-line)#
```

stopbits

This command sets the number of the stop bits transmitted per byte. Use the no form to restore the default setting.

Syntax

stopbits {1 | 2}

1 - One stop bit

2 - Two stop bits

Default Setting

1 stop bit

Command Mode

Line Configuration

Example

To specify 2 stop bits, enter this command:

```
Console(config-line)#stopbits 2
Console(config-line)#
```

disconnect

This command terminates an SSH, Telnet, or console connection.

Syntax

disconnect session-id

session-id – The session identifier for an SSH, Telnet or console

connection. (Range: 0-4)

Command Mode

Privileged Exec

Command Usage

Specifying session identifier "0" will disconnect the console connection. Specifying any other identifiers for an active session will disconnect an SSH or Telnet connection.

Example

```
Console#disconnect 1
Console#
```

Related Commands

show ssh

show users

show line

This command displays the terminal line's parameters.

Syntax

show line [console | vty]

console -Console terminal line.

vty - Virtual terminal for remote console access (i.e., Telnet).

Default Setting

Shows all lines

Command Mode

Normal Exec, Privileged Exec

Example

To show all lines, enter this command:

```
Console#show line
 Console Configuration:
```

```
  Password Threshold:   3 times
  Interactive Timeout: 65535 sec
  Login Timeout: Disabled
  Silent Time:          Disabled
  Baudrate:              9600
  Databits:              8
  Parity:                None
  Stopbits:              1

VTY Configuration:
  Password Threshold:   3 times
  Interactive Timeout: 300 sec
  Login Timeout: 1 sec

console#
```

5.7 Event Logging Commands

This section describes commands used to configure event logging on the switch.

Command	Function	Mode
logging on	Controls logging of error messages	GC
logging history	Limits syslog messages saved to switch memory based on severity	GC
logging host	Adds a syslog server host IP address that will receive logging messages	GC
logging facility	Sets the facility type for remote logging of syslog messages	GC
logging trap	Limits syslog messages saved to a remote server based on severity	GC
clear log	Clears messages from the logging buffer	PE

Table 5-14 Event Logging Commands

logging on

This command controls logging of error messages, sending debug or error messages to switch memory. The no form disables the logging process.

Syntax

[no] logging on

Default Setting

None

Command Mode

Global Configuration

Command Usage

The logging process controls error messages saved to switch memory or sent to remote syslog servers. You can use the logging history command to control the type of error messages that are stored in memory. You can use the logging trap command to control the type of error messages that are sent to specified syslog servers.

Example

```
Console(config)#logging on
Console(config)#
```

Related Commands

logging history

logging trap

clear log

logging history

This command limits syslog messages saved to switch memory based on severity. The no form returns the logging of syslog messages to the default level.

Syntax

logging history {flash | ram} level

no logging history {flash | ram}

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

level -One of the levels listed below. Messages sent include the selected level down to level 0. (Range: 0-7)

Table 4-15 Logging Levels

Level	Severity Name	Description
7	debugging	Debugging messages
6	informational	Informational messages only
5	notifications	Normal but significant condition, such as cold start
4	warnings	Warning conditions (e.g., return false, unexpected return)
3	errors	Error conditions (e.g., invalid input, default used)
2	critical	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
1	alerts	Immediate action needed

0	emergencies	System unusable

* There are only Level 2, 5 and 6 error messages for the current firmware release.

Default Setting

Flash: errors (level 3 - 0)

RAM: warnings (level 7 -0)

Command Mode

Global Configuration

Command Usage

The message level specified for flash memory must be a higher priority (i.e., numerically lower) than that specified for RAM.

Example

```
Console(config)#logging history ram 0
Console(config)#
```

logging host

This command adds a syslog server host IP address that will receive logging messages. Use the no form to remove a syslog server host.

Syntax

[no] logging host host_ip_address host_ip_address - The IP address of a syslog server.

Default Setting

None

Command Mode

Global Configuration

Command Usage

Use this command more than once to build up a list of host IP addresses.

The maximum number of host IP addresses allowed is five.

Example

```
Console(config)#logging host 10.1.0.3
Console(config)#
```

logging facility

This command sets the facility type for remote logging of syslog messages. Use the no form to return the type to the default.

Syntax

[no] logging facility type

type - A number that indicates the facility used by the syslog server to dispatch log messages to an appropriate service. (Range: 16-23)

Default Setting

23

Command Mode

Global Configuration

Command Usage

The command specifies the facility type tag sent in syslog messages. (See RFC 3164.) This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to sort messages or to store messages in the corresponding database.

Example

```
Console(config)# logging facility 19
Console(config)#
```

logging trap

This command enables the logging of system messages to a remote server, or limits the syslog messages saved to a remote server based on severity. Use this command without a specified level to enable remote logging. Use the no form to disable remote logging.

Syntax

logging trap [level] no logging trap

level - One of the level arguments listed below. Messages sent include the selected level up through level 0. (Refer to the table on page 4-50.)

Default Setting

Enabled

Level 7 - 0

Command Mode

Global Configuration

Command Usage

Using this command with a specified level enables remote logging and sets the minimum severity level to be saved.

Using this command without a specified level also enables remote logging, but restores the minimum severity level to the

default.

Example

```
Console(config)#logging trap 4
Console(config)#
```

clear log

This command clears messages from the log buffer.

Syntax

clear log [flash | ram]

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

Default Setting

Flash and RAM

Command Mode

Privileged Exec

Example

```
Console#clear log
Console#
```

Related Commands

show logging

show logging

This command displays the configuration settings for logging messages to local switch memory, to an SMTP event handler, or to a remote syslog server.

Syntax

show logging {flash | ram | sendmail | trap}

flash - Displays settings for storing event messages in flash memory (i.e., permanent memory).

ram - Displays settings for storing event messages in temporary RAM (i.e., memory flushed on power reset).

sendmail - Displays settings for the SMTP event handler (page 4-58).

trap - Displays settings for the trap function.

Default Setting

None

Command Mode

Privileged Exec

Example

The following example shows that system logging is enabled, the message level for flash memory is "errors" (i.e., default level 3 - 0), the message level for RAM is "informational" (i.e., default level 7 -0).

```
Console#show logging flash
Syslog logging:          Enabled
History logging in FLASH: level errors
Console#show logging ram
Syslog logging:          Enabled
History logging in RAM: level debugging
Console#
```

Table 4-16 show logging flash/ram - display description

Field	Description
Syslog logging	Shows if system logging has been enabled via the logging on command.
History logging in FLASH	The message level(s) reported based on the logging history command.
History logging in RAM	The message level(s) reported based on the logging history command.

The following example displays settings for the trap function.

```
Console#show logging trap
Syslog logging: Enable
REMOTELOG status: disable
REMOTELOG facility type: local use 7
REMOTELOG level type: Debugging messages
REMOTELOG server IP address: 1.2.3.4
REMOTELOG server IP address: 0.0.0.0
REMOTELOG server IP address: 0.0.0.0
REMOTELOG server IP address: 0.0.0.0
REMOTELOG server IP address: 0.0.0.0
Console#
```

Table 4-17 show logging trap - display description

Field	Description
Syslog logging	Shows if system logging has been enabled via the logging on command.
REMOTELOG status	Shows if remote logging has been enabled via the logging trap command.
REMOTELOG facility type	The facility type for remote logging of syslog messages as specified in the logging facility command.
REMOTELOG level type	The severity threshold for syslog messages sent to a remote server as specified in the logging trap command.
REMOTELOG server IP address	The address of syslog servers as specified in the logging host command.

Related Commands

show logging sendmail

show log

This command displays the system and event messages stored in memory.

Syntax

show log {flash | ram} [login]

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

login - Shows the login record only.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

This command shows the system and event messages stored in memory, including the time stamp, message level (page 4-50), program module, function, and event number.

Example

The following example shows sample messages stored in RAM.

```
Console#show log ram

[1] 00:00:38 2001-01-01
    "Unit 1, Port    1 link-up notification."
    level: 6, module: 5, function: 1, and event no.: 1
```

```
[0] 00:00:37 2001-01-01
    "System coldStart notification."
    level: 6, module: 5, function: 1, and event no.: 1

Console#
```

5.8 SMTP Alert Commands

These commands configure SMTP event handling, and forwarding of alert messages to the specified SMTP servers and email recipients.

Command	Function	Mode
logging sendmail host	SMTP servers to receive alert messages	GC
logging sendmail level	Severity threshold used to trigger alert messages	GC
logging sendmail source-email	Email address used for "From" field of alert messages	GC
logging sendmail destination-email	Email recipients of alert messages	GC
logging sendmail	Enables SMTP event handling	GC
show logging sendmail	Displays SMTP event handler settings	NE, PE

Table 4-18 SMTP Alert Commands

logging sendmail host

This command specifies SMTP servers that will be sent alert messages. Use the no form to remove an SMTP server.

Syntax

[no] logging sendmail host ip_address

ip_address - IP address of an SMTP server that will be sent alert messages for event handling.

Default Setting

None

Command Mode

Global Configuration

Command Usage

You can specify up to three SMTP servers for event handing. However, you must enter a separate command to specify each server.

To send email alerts, the switch first opens a connection, sends all the email alerts waiting in the queue one by one, and finally closes the connection.

To open a connection, the switch first selects the server that successfully sent mail during the last connection, or the first

server configured by this command. If it fails to send mail, the switch selects the next server in the list and tries to send mail again. If it still fails, the system will repeat the process at a periodic interval. (A trap will be triggered if the switch cannot successfully open a connection.)

Example

```
Console(config)# logging sendmail host 192.168.1.200
Console(config)#
```

logging sendmail level

This command sets the severity threshold used to trigger alert messages.

Syntax

logging sendmail level level

level -One of the system message levels (page 4-50). Messages sent include the selected level down to level 0. (Range: 0-7; Default: 7)

Default Setting

Level 7

Command Mode

Global Configuration

Command Usage

The specified level indicates an event threshold. All events at this level or higher will be sent to the configured email recipients. (For example, using Level 7 will report all events from level 7 to level 0.)

Example

This example will send email alerts for system errors from level 4 through 0.

```
Console(config)#logging sendmail level 4
Console(config)#
```

logging sendmail source-email

This command sets the email address used for the "From" field in alert messages. Use the no form to delete the source email address.

Syntax

[no] logging sendmail source-email email-address

email-address -The source email address used in alert messages. (Range: 1-41 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

You may use an symbolic email address that identifies the switch, or the address of an administrator responsible for the switch.

Example

This example will set the source email marcl@planet.com.tw.

```
Console(config)#logging sendmail source-email marcl@planet.com.tw
Console(config)#
```

logging sendmail destination-email

This command specifies the email recipients of alert messages. Use the no form to remove a recipient.

Syntax

no] logging sendmail destination-email email-address

email-address -The source email address used in alert messages.

(Range: 1-41 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

You can specify up to five recipients for alert messages. However, you must

enter a separate command to specify each recipient.

Example

```
Console(config)#logging sendmail destination-email ted@this-company.com
Console(config)#
```

logging sendmail

This command enables SMTP event handling. Use the no form to disable this function.

Syntax

[no] logging sendmail

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#logging sendmail
Console(config)#
```

show logging sendmail

This command displays the settings for the SMTP event handler.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show logging sendmail
SMTP servers

1. 192.168.1.200
SMTP minimum severity level: 4
SMTP destination email addresses

1. geoff@acme.com
SMTP source email address:    john@acme.com
SMTP status:                  Enabled

Console#
```

5.9 Time Commands

The system clock can be dynamically set by polling a set of specified time servers (NTP or SNTP). Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. If the clock is not set, the switch will only record the time from the factory default set at the last bootup.

Command	Function	Mode
sntp client	Accepts time from specified time servers	GC
sntp server	Specifies one or more time servers	GC
sntp poll	Sets the interval at which the client polls for time	GC
show sntp	Shows current SNTP configuration settings	NE, PE
clock timezone	Sets the time zone for the switch's internal clock	GC

calendar set	Sets the system date and time	PE
show calendar	Displays the current date and time setting	NE, PE

Table 5-19 Time Commands

sntp client

This command enables SNTP client requests for time synchronization from NTP or SNTP time servers specified with the sntp servers command. Use the no form to disable SNTP client requests.

Syntax

[no] sntp client

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The time acquired from time servers is used to record accurate dates and times for log events. Without SNTP, the switch only records the time starting from the factory default set at the last bootup (i.e., 00:00:00, Jan. 1, 2001).

This command enables client time requests to time servers specified via the sntp servers command. It issues time synchronization requests based on the interval set via the sntp poll command.

Example

```
Console(config)#sntp server 10.1.0.19
Console(config)#sntp poll 60
Console(config)#sntp client
Console(config)#end
Console#show sntp
Current time:    Dec 23 02:52:44 2002
Poll interval: 60
Current mode: unicast
SNTP status: Enabled
SNTP server: 10.1.0.19 0.0.0.0 0.0.0.0
Current server: 10.1.0.19
Console#
```

Related Commands

sntp server

sntp poll

show sntp

sntp server

This command sets the IP address of the servers to which SNTP time requests are issued. Use the this command with no arguments to clear all time servers from the current list.

Syntax

sntp server [ip1 [ip2 [ip3]]] ip - IP address of a time server (NTP or SNTP). (Range: 1-3 addresses)

Default Setting

None

Command Mode

Global Configuration

Command Usage

This command specifies time servers from which the switch will poll for time updates when set to SNTP client mode. The client will poll the time servers in the order specified until a response is received. It issues time synchronization requests based on the interval set via the sntp poll command.

Example

```
Console(config)#sntp server 10.1.0.19
Console(config)#
```

Related Commands

sntp client

sntp poll

show sntp

sntp poll

This command sets the interval between sending time requests when the switch is set to SNTP client mode. Use the no form to restore to the default.

Syntax

sntp poll seconds

no sntp poll

seconds - Interval between time requests. (Range: 16-16384 seconds)

Default Setting

16 seconds

Command Mode

Global Configuration

Example

```
Console(config)#sntp poll 60
Console(config)#
```

Related Commands

sntp client

show sntp

This command displays the current time and configuration settings for the SNTP client, and indicates whether or not the local time has been properly updated.

Command Mode

Normal Exec, Privileged Exec

Command Usage

This command displays the current time, the poll interval used for sending time synchronization requests, and the current SNTP mode (i.e., unicast).

Example

```
Console#show sntp
Current time:    Dec 23 05:13:28 2002
Poll interval: 16
Current mode:    unicast
SNTP status : Enabled
SNTP server 137.92.140.80 0.0.0.0 0.0.0.0
Current server: 137.92.140.80
Console#
```

clock timezone

This command sets the time zone for the switch's internal clock.

Syntax

clock timezone name hour hours minute minutes {before-utc | after-utc}

name - Name of timezone, usually an acronym. (Range: 1-29 characters)

hours - Number of hours before/after UTC. (Range: 0-13 hours)

minutes - Number of minutes before/after UTC. (Range: 0-59 minutes)

before-utc - Sets the local time zone before (east) of UTC.

after-utc - Sets the local time zone after (west) of UTC.

Default Setting

None

Command Mode

Global Configuration

Command Usage

This command sets the local time zone relative to the Coordinated Universal Time (UTC, formerly Greenwich Mean Time or GMT), based on the earth's prime meridian, zero degrees longitude. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC.

Example

```
Console(config)#clock timezone Japan hours 8 minute 0 after-UTC
Console(config)#
```

Related Commands

show sntp

calendar set

This command sets the system clock. It may be used if there is no time server on your network, or if you have not configured the switch to receive signals from a time server.

Syntax

calendar set hour min sec {day month year | month day year}

hour - Hour in 24-hour format. (Range: 0-23)

min - Minute. (Range: 0-59)

sec - Second. (Range: 0-59)

day - Day of month. (Range: 1-31)

month -january | february | march | april | may | june | july | august | september | october | november | december

year - Year (4-digit). (Range: 2001-2100)

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows how to set the system clock to 15:12:34, April 1st, 2004.

```
Console#calendar set 15 12 34 1 April 2004
Console#
```

show calendar

This command displays the system clock.

Default Setting

None

4-62

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show calendar

 15:12:43 April 1 2004
Console#
```

5.10 Switch Cluster Commands

Switch Clustering is a method of grouping switches together to enable centralized management through a single unit. Switches that support clustering can be grouped together regardless of physical location or switch type, as long as they are connected to the same local network.

Command	Function	Mode
cluster	Configures clustering on the switch	GC
cluster commander	Configures the switch as a cluster Commander	GC
cluster ip-pool	Sets the cluster IP address pool for Members	GC
cluster member	Sets Candidate switches as cluster members	GC
rcommand	Provides configuration access to Member switches	GC
show cluster	Displays the switch clustering status	PE
show cluster members	Displays current cluster Members	PE
show cluster candidates	Displays current cluster Candidates in the network	PE

Table 5-20 Switch Cluster Commands

Using Switch Clustering

A switch cluster has a primary unit called the "Commander" which is used to manage all other "Member" switches in the cluster. The management station uses both Telnet and the web interface to communicate directly with the Commander through its IP address, while the Commander manages Member switches using the cluster's "internal" IP addresses.

Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These "Candidate" switches only become cluster Members when manually selected by the administrator through the

management station.

Cluster Member switches can be managed through only using a Telnet connection to the Commander. From the Commander CLI prompt, use the rcommand (see page 4-66) to connect to the Member switch.

cluster

This command enables clustering on the switch. Use the no form to disable clustering.

Syntax

[no] cluster

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

To create a switch cluster, first be sure that clustering is enabled on the switch (the default is enabled), then set the switch as a Cluster Commander. Set a Cluster IP Pool that does not conflict with any other IP subnets in the network. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.

Cluster switches are limited to the same Ethernet broadcast domain.

There can be up to 100 candidates and 36 member switches in one cluster.

A switch can only be a Member of one cluster.

Configured switch clusters are maintained across power resets and network changes.

Example

```
Console(config)#cluster
Console(config)#
```

cluster commander

This command enables the switch as a cluster Commander. Use the no form to disable the switch as a cluster Commander.

Syntax

[no] cluster commander

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These "Candidate" switches only become cluster Members when manually selected by the administrator through the management station.

Cluster Member switches can be managed through using a Telnet connection to the Commander. From the Commander CLI prompt, use the rcommand id command to connect to the Member switch.

Example

```
Console(config)#cluster commander
Console(config)#
```

cluster ip-pool

This command sets the cluster IP address pool. Use the no form to reset to the default address.

Syntax

cluster ip-pool ip-address no cluster ip-pool

ip-address - The base IP address for IP addresses assigned to cluster Members. The IP address must start 10.x.x.x.

Default Setting

10.254.254.1

Command Mode

Global Configuration

Command Usage

An "internal" IP address pool is used to assign IP addresses to Member switches in the cluster. Internal cluster IP addresses are in the form 10.x.x.member-ID. Only the base IP address of the pool needs to be set since Member IDs can only be between 1 and 36.

Set a Cluster IP Pool that does not conflict with addresses in the network IP subnet. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.

You cannot change the cluster IP pool when the switch is currently in Commander mode. Commander mode must first be disabled.

Example

```
Console(config)#cluster ip-pool 10.2.3.4
Console(config)#
```

cluster member

This command configures a Candidate switch as a cluster Member. Use the no form to remove a Member switch from the

cluster.

Syntax

cluster member mac-address mac-address id member-id no cluster member id member-id

mac-address - The MAC address of the Candidate switch.

member-id - The ID number to assign to the Member switch. (Range: 1-36)

Default Setting

No Members

Command Mode

Global Configuration

Command Usage

The maximum number of cluster Members is 36.

The maximum number of switch Candidates is 100.

Example

```
Console(config)#cluster member mac-address 00-12-34-56-78-9a id 5
Console(config)#
```

rcommand

This command provides access to a cluster Member CLI for configuration.

Syntax

rcommand id member-id member-id - The ID number of the Member switch. (Range: 1-36)

Command Mode

Privileged Exec

Command Usage

This command only operates through a Telnet connection to the Commander switch. Managing cluster Members using the local console CLI on the Commander is not supported.

There is no need to enter the username and password for access to the Member switch CLI.

Example

```
Vty-0#rcommand id 1
  CLI session with the 24/48 L2/L4 GE Switch is opened.
  To end the CLI session, enter [Exit].
Vty-0#
```

show cluster

This command shows the switch clustering configuration.

Command Mode

Privileged Exec

Example

```
Console#show cluster
Role: commander
Interval heartbeat: 30
Heartbeat loss count: 3
Number of Members: 1
Number of Candidates: 2
Console#
```

show cluster members

This command shows the current switch cluster members.

Command Mode

Privileged Exec

Example

```
Console#show cluster members
Cluster Members:
ID: 1
Role:            Active member
IP Address:   10.254.254.2
MAC Address: 00-30-4f-28-40-c0
Description: 24/48 L2/L4 IPV4/IPV6 GE Switch
Console#
```

show cluster candidates

This command shows the discovered Candidate switches in the network.

Command Mode

Privileged Exec

Example

```
Console#show cluster candidates
Cluster Candidates:
Role Mac              Description
ACTIVE MEMBER     00-30-4f-23-49-c0 24/48 L2/L4 IPV4/IPV6 GE Switch
CANDIDATE         00-40-4f-0b-47-a0 24/48 L2/L4 IPV4/IPV6 GE Switch
Console#
```

5.11 SNMP Commands

Controls access to this switch from management stations using the Simple Network Management Protocol (SNMP), as well as the error types sent to trap managers.

SNMP Version 3 also provides security features that cover message integrity, authentication, and encryption; as well as controlling user access to specific areas of the MIB tree. To use SNMPv3, first set an SNMP engine ID (or accept the default), specify read and write access views for the MIB tree, configure SNMP user groups with the required security model (i.e., SNMP v1, v2c or v3) and security level (i.e., authentication and privacy), and then assign SNMP users to these groups, along with their specific authentication and privacy passwords.

Command	Function	Mode
snmp-server	Enables the SNMPv3 server	GC
show snmp	Displays the status of SNMP communications	NE, PE
snmp-server community	Sets up the community access string to permit access to SNMP commands	GC
snmp-server contact	Sets the system contact string	GC
snmp-server location	Sets the system location string	GC
snmp-server host	Specifies the recipient of an SNMP notification operation	GC
snmp-server enable traps	Enables the device to send SNMP traps (i.e., SNMPnotifications)	GC
snmp-server engine-id	Sets the SNMPv3 engine ID	GC
show snmp engine-id	Shows the SNMPv3 engine ID	PE
snmp-server view	Adds an SNMPv3 view	GC
show snmp view	Shows the SNMPv3 views	PE
snmp-server group	Adds an SNMPv3 group, mapping users to views	GC
show snmp group	Shows the SNMPv3 groups	PE
snmp-server user	Adds a user to an SNMPv3 group	GC
show snmp user	Shows the SNMPv3 users	PE

Table 5-21 SNMP Command

snmp-server

This command enables the SNMPv3 engine and services for all management clients (i.e., versions 1, 2c, 3). Use the no form to disable the server.

Syntax

[no] snmp-server

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server
Console(config)#
```

show snmp

This command can be used to check the status of SNMP communications.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

This command provides information on the community access strings, counter information for SNMP input and output protocol data units, and whether or not SNMP logging has been enabled with the snmp-server enable traps command.

Example

```
Console#show snmp

SNMP Agent: enabled

SNMP traps:
  Authentication: enable
     Link-up-down: enable

SNMP communities:

private, and the privilege is read-write
```

```
public, and the privilege is read-only



0 SNMP packets input
      0 Bad SNMP version errors
      0 Unknown community name
      0 Illegal operation for community name supplied
      0 Encoding errors
      0 Number of requested variables
      0 Number of altered variables
      0 Get-request PDUs
      0 Get-next PDUs
      0 Set-request PDUs

0 SNMP packets output
      0 Too big errors
      0 No such name errors
      0 Bad values errors
      0 General errors
      0 Response PDUs
      0 Trap PDUs

SNMP logging: disabled
Console#
```

snmp-server community

This command defines the SNMP v1 and v2c community access string. Use the no form to remove the specified community string.

Syntax

snmp-server community string [ro|rw] no snmp-server community string

string - Community string that acts like a password and permits access to the SNMP protocol. (Maximum length: 32 characters, case sensitive; Maximum number of strings: 5)

ro - Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.

rw - Specifies read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

Default Setting

public - Read-only access. Authorized management stations are only able to retrieve MIB objects.

private - Read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server community alpha rw
Console(config)#
```

snmp-server contact

This command sets the system contact string. Use the no form to remove the system contact information.

Syntax

snmp-server contact string no snmp-server contact

string - String that describes the system contact information. (Maximum length: 255 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server contact Paul
Console(config)#
```

Related Commands

snmp-server location

snmp-server location

This command sets the system location string. Use the no form to remove the location string.

Syntax

snmp-server location text no snmp-server location

text -String that describes the system location.

(Maximum length: 255 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server location WC-19
Console(config)#
```

Related Commands

snmp-server contact

snmp-server host

This command specifies the recipient of a Simple Network Management Protocol notification operation. Use the no form to remove the specified host.

Syntax

snmp-server host host-addr [inform [retry retries | timeout seconds]] community-string [version {1 | 2c | 3 {auth | noauth | priv} [udp-port port]} no snmp-server host host-addr

host-addr - Internet address of the host (the targeted recipient). (Maximum host addresses: 5 trap destination IP address entries) inform - Notifications are sent as inform messages.

Note that this option is only available for version 2c and 3 hosts. (Default: traps are used) -retries - The maximum number of times to resend an inform message if the recipient does not acknowledge receipt. (Range: 0-255; Default: 3)

-seonds - The number of seconds to wait for an acknowledgment before resending an inform message. (Range: 0-2147483647 centiseconds; Default: 1500 centiseconds)

community-string -Password-like community string sent with the notification operation to SNMP V1 and V2c hosts. Although you can set this string using the snmp-server host command by itself, we recommend that you define this string using the snmp-server community command prior to using the snmp-server host command. (Maximum length: 32 characters)

•version - Specifies whether to send notifications as SNMP Version 1, 2c or 3 traps. (Range: 1, 2c, 3; Default: 1) -auth | noauth | priv - This group uses SNMPv3 with authentication, no

authentication, or with authentication and privacy. See "Simple Network Management Protocol" on page 3-39 for further information about these authentication and encryption options.

port - Host UDP port to use. (Range: 1-65535; Default: 162)

Default Setting

Host Address: None

Notification Type: Traps

SNMP Version: 1

UDP Port: 162

Command Mode

Global Configuration

Command Usage

If you do not enter an snmp-server host command, no notifications are sent. In order to configure the switch to send

SNMP notifications, you must enter at least one snmp-server host command. In order to enable multiple hosts, you must issue a separate snmp-server host command for each host.

The snmp-server host command is used in conjunction with the snmp-server enable traps command. Use the snmp-server enable traps command to enable the sending of traps or informs and to specify which SNMP notifications are sent globally. For a host to receive notifications, at least one snmp-server enable traps command and the snmp-server host command for that host must be enabled.

Some notification types cannot be controlled with the snmp-server enable traps command. For example, some notification types are always enabled.

Notifications are issued by the switch as trap messages by default. The recipient of a trap message does not send a response to the switch. Traps are therefore not as reliable as inform messages, which include a request for acknowledgement of receipt. Informs can be used to ensure that critical information is received by the host. However, note that informs consume more system resources because they must be kept in memory until a response is received. Informs also add to network traffic. You should consider these effects when deciding whether to issue notifications as traps or informs.

To send an inform to a SNMPv2c host, complete these steps:

Enable the SNMP agent (page 4-68).

Allow the switch to send SNMP traps; i.e., notifications (page 4-74).

Specify the target host that will receive inform messages with the snmp-server host command as described in this section.

Create a view with the required notification messages (page 4-77).

Create a group that includes the required notify view (page 4-79).

To send an inform to a SNMPv3 host, complete these steps:

Enable the SNMP agent (page 4-68).

Allow the switch to send SNMP traps; i.e., notifications (page 4-74).

Specify the target host that will receive inform messages with the snmp-server host command as described in this section.

Create a view with the required notification messages (page 4-77).

Create a group that includes the required notify view (page 4-79).

Specify a remote engine ID where the user resides (page 4-75).

Then configure a remote user (page 4-81).

The switch can send SNMP Version 1, 2c or 3 notifications to a host IP address, depending on the SNMP version that the management station supports. If the snmp-server host command does not specify the SNMP version, the default is to send SNMP version 1 notifications.

If you specify an SNMP Version 3 host, then the community string is interpreted as an SNMP user name. If you use the V3 "auth" or "priv" options, the user name must first be defined with the snmp-server user command. Otherwise, the authentication password and/or privacy password will not exist, and the switch will not authorize SNMP access for the host. However, if you specify a V3 host with the "noauth" option, an SNMP user account will be generated, and the switch will authorize SNMP access for the host.

Example

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#
```

Related Commands

snmp-server enable traps

snmp-server enable traps

This command enables this device to send Simple Network Management Protocol traps or informs (i.e., SNMP notifications). Use the no form to disable SNMP notifications.

Syntax

[no] snmp-server enable traps [authentication | link-up-down]

authentication - Keyword to issue authentication failure notifications.

link-up-down - Keyword to issue link-up or link-down notifications.

Default Setting

Issue authentication and link-up-down traps.

Command Mode

Global Configuration

Command Usage

If you do not enter an snmp-server enable traps command, no notifications controlled by this command are sent. In order to configure this device to send SNMP notifications, you must enter at least one snmp-server enable traps command. If you enter the command with no keywords, both authentication and link-up-down notifications are enabled. If you enter the command with a keyword, only the notification type related to that keyword is enabled.

The snmp-server enable traps command is used in conjunction with the snmp-server host command. Use the snmp-server host command to specify which host or hosts receive SNMP notifications. In order to send notifications, you must configure at least one snmp-server host command.

The authentication, link-up, and link-down traps are legacy notifications, and therefore when used for SNMP Version 3 hosts, they must be enabled in conjunction with the corresponding entries in the Notify View assigned by the snmp-server group command (page 4-79).

Example

```
Console(config)#snmp-server enable traps link-up-down
Console(config)#
```

Related Commands

snmp-server host

snmp-server engine-id

This command configures an identification string for the SNMPv3 engine. Use the no form to restore the default.

Syntax

snmp-server engine-id {local | remote {ip-address}} engineid-string no snmp-server engine-id {local | remote {ip-address}}

local - Specifies the SNMP engine on this switch.

remote - Specifies an SNMP engine on a remote device.

ip-address -The Internet address of the remote device.

engineid-string -String identifying the engine ID. (Range: 10-64 hexadecimal characters representing 5-32 octets)

Default Setting

A unique engine ID is automatically generated by the switch based on its MAC address.

Command Mode

Global Configuration

Command Usage

An SNMP engine is an independent SNMP agent that resides either on this switch or on a remote device. This engine protects against message replay, delay, and redirection. The engine ID is also used in combination with user passwords to generate the security keys for authenticating and encrypting SNMPv3 packets.

A remote engine ID is required when using SNMPv3 informs. (See snmp-server host on page 4-72.) The remote engine ID is used to compute the security digest for authenticating and encrypting packets sent to a user on the remote host. SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

A local engine ID is automatically generated that is unique to the switch. This is referred to as the default engine ID. If the local engine ID is deleted or changed, all SNMP users will be cleared. You will need to reconfigure all existing users (page 4-81).

Example

```
Console(config)#snmp-server engine-id local 0123456789
Console(config)#snmp-server engineID remote 9876543210 192.168.1.19
Console(config)#
```

Related Commands

snmp-server host

show snmp engine-id

This command shows the SNMP engine ID.

Command Mode

Privileged Exec

Example

This example shows the default engine ID.

```
Console#show snmp engine-id Local SNMP engineID:
8000002a8000000000e8666672 Local SNMP engineBoots: 1
Remote SNMP engineID                    IP address
80000000030004e2b316c54321              192.168.1.19
Console#
```

Field	Description
Local SNMP engineID	String identifying the engine ID.
Local SNMP engineBoots	The number of times that the engine has (re-)initialized since the snmp EngineID was last configured.
Remote SNMP engineID	String identifying an engine ID on a remote device.
IP address	IP address of the device containing the corresponding remote SNMP engine.

snmp-server view

This command adds an SNMP view which controls user access to the MIB. Use the no form to remove an SNMP view.

Syntax

snmp-server view view-name oid-tree {included | excluded} no snmp-server view view-name

•view-name -Name of an SNMP view. (Range: 1-64 characters)

•oid-tree - Object identifier of a branch within the MIB tree. Wild cards can be used to mask a specific portion of the OID string. (Refer to the examples.)

included - Defines an included view.

excluded - Defines an excluded view.

Default Setting

defaultview (includes access to the entire MIB tree)

Command Mode

Global Configuration

Command Usage

Views are used in the snmp-server group command to restrict user access to specified portions of the MIB tree.

The predefined view "defaultview" includes access to the entire MIB tree.

Examples

This view includes MIB-2.

```
Console(config)#snmp-server view mib-2 1.3.6.1.2.1 included
Console(config)#
This view includes the MIB-2 interfaces table, ifDescr. The wild card is used to select all the index values in this table.
Console(config)#snmp-server view ifEntry.2 1.3.6.1.2.1.2.2.1.*.2 included
Console(config)#

This view includes the MIB-2 interfaces table, and the mask selects all index entries.
Console(config)#snmp-server view ifEntry.a 1.3.6.1.2.1.2.2.1.1.* included
Console(config)#
```

show snmp view

This command shows information on the SNMP views.

Command Mode

Privileged Exec

Example

```
Console#show snmp view
View Name: mib-2
Subtree OID: 1.2.2.3.6.2.1
View Type: included
Storage Type: permanent
Row Status: active

View Name: defaultview
Subtree OID: 1
View Type: included
Storage Type: volatile
Row Status: active

Console#
```

Field	Description
View Name	Name of an SNMP view.
Subtree OID	A branch in the MIB tree.
View Type	Indicates if the view is included or excluded.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

Table 5-23 show snmp view - display description

snmp-server group

This command adds an SNMP group, mapping SNMP users to SNMP views. Use the no form to remove an SNMP group.

Syntax

snmp-server group groupname {v1 | v2c | v3 {auth | noauth | priv}} [read readview] [write writeview] [notify notifyview] no snmp-server group groupname

groupname -Name of an SNMP group. (Range: 1-32 characters)

v1 | v2c | v3 - Use SNMP version 1, 2c or 3.

auth | noauth | priv - This group uses SNMPv3 with authentication, no authentication, or with authentication and privacy. See "Simple Network Management Protocol" on page 3-39 for further information about these authentication and encryption options.

readview - Defines the view for read access. (1-64 characters)

writeview - Defines the view for write access. (1-64 characters)

notifyview - Defines the view for notifications. (1-64 characters)

Default Setting

Default groups: public19 (read only), private20 (read/write)

readview - Every object belonging to the Internet OID space (1.3.6.1).

writeview - Nothing is defined.

notifyview -Nothing is defined.

Command Mode

Global Configuration

Command Usage

A group sets the access policy for the assigned users.

When authentication is selected, the MD5 or SHA algorithm is used as specified in the snmp-server user command.

When privacy is selected, the DES 56-bit algorithm is used for data encryption.

For additional information on the notification messages supported by this switch, see "Supported Notification Messages" on page 3-51. Also, note that the authentication, link-up and link-down messages are legacy traps and must therefore be enabled in conjunction with the snmp-server enable traps command (page 4-74).

Example

```
Console(config)#snmp-server group r&d v3 auth write daily
Console(config)#
```

No view is defined.

Maps to the defaultview.

show snmp group

Four default groups are provided – SNMPv1 read-only access and read/write access, and SNMPv2c read-only access and read/write access.

Command Mode

Privileged Exec

Example

```
Console#show snmp group
Group Name: r&d
Security Model: v3
Read View: defaultview
Write View: daily
Notify View: none
Storage Type: permanent
Row Status: active

Group Name: public
Security Model: v1
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: public
Security Model: v2c
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
```

```
Row Status: active

Group Name: private
Security Model: v1
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: private
Security Model: v2c
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active

Console#
```

Field	Description
groupname	Name of an SNMP group.
security model	The SNMP version.
readview	The associated read view.
writeview	The associated write view.
notifyview	The associated notify view.
storage-type	The storage type for this entry.
Row Status	The row status of this entry.

snmp-server user

This command adds a user to an SNMP group, restricting the user to a specific SNMP Read, Write, or Notify View. Use the no form to remove a user from an SNMP group.

Syntax

snmp-server user username groupname [remote ip-address] {v1 | v2c | v3 [encrypted] [auth {md5 | sha} auth-password [priv des56 priv-password]] no snmp-server user username {v1 | v2c | v3 | remote}

username - Name of user connecting to the SNMP agent.

(Range: 1-32 characters)\

groupname -Name of an SNMP group to which the user is assigned. (Range: 1-32 characters)

remote - Specifies an SNMP engine on a remote device.

ip-address -The Internet address of the remote device.

v1 | v2c | v3 - Use SNMP version 1, 2c or 3.

encrypted -Accepts the password as encrypted input.

auth - Uses SNMPv3 with authentication.

md5 | sha - Uses MD5 or SHA authentication.

auth-password -Authentication password. Enter as plain text if the encrypted option is not used. Otherwise, enter an encrypted password. (A minimum of eight characters is required.)

priv des56 - Uses SNMPv3 with privacy with DES56 encryption.

priv-password - Privacy password. Enter as plain text if the encrypted option is not used. Otherwise, enter an encrypted password.

Default Setting

None

Command Mode

Global Configuration

Command Usage

The SNMP engine ID is used to compute the authentication/privacy digests from the password. You should therefore configure the engine ID with the snmp-server engine-id command before using this configuration command.

Before you configure a remote user, use the snmp-server engine-id command (page 4-75) to specify the engine ID for the remote device where the user resides. Then use the snmp-server user command to specify the user and the IP address for the remote device where the user resides. The remote agent's SNMP engine ID is used to compute authentication/privacy digests from the user's password. If the remote engine ID is not first configured, the snmp-server user command specifying a remote user will fail.

SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

Example

```
Console(config)#snmp-server user steve group r&d v3 auth md5 greenpeace
priv des56 einstien

Console(config)#snmp-server user mark group r&d remote 192.168.1.19 v3
auth md5 greenpeace priv des56 einstien

Console(config)#
```

show snmp user

This command shows information on SNMP users.

Command Mode

Privileged Exec

Example

```
Console#show snmp user
EngineId: 800000ca030030f1df9ca00000
User Name: steve
Authentication Protocol: md5
Privacy Protocol: des56
Storage Type: nonvolatile
Row Status: active

SNMP remote user
EngineId: 80000000030004e2b316c54321
User Name: mark
Authentication Protocol: mdt
Privacy Protocol: des56
Storage Type: nonvolatile
Row Status: active

Console#
```

Field	Description
EngineId	String identifying the engine ID.
User Name	Name of user connecting to the SNMP agent.
Authentication Protocol	The authentication protocol used with SNMPv3.
Privacy Protocol	The privacy protocol used with SNMPv3.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.
SNMP remote user	A user associated with an SNMP engine on a remote device.

5.12 Authentication Commands

You can configure this switch to authenticate users logging into the system for management access using local or RADIUS authentication methods. You can also enable port-based authentication for network client access using IEEE 802.1X.

Command	Function	Mode
User Accounts	Configures the basic user names and passwords for management access	
Authentication Sequence	Defines logon authentication method and precedence	
RADIUS Client	Configures settings for authentication via a RADIUS server	
TACACS+ Client	Configures settings for authentication via a TACACS+ server	
AAA	Configures authentication, authorization, and accounting fornetwork access	
Web Server	Enables management access via a web browser	
Telnet Server	Enables management access via Telnet	
Secure Shell	Provides secure replacement for Telnet	
Port Authentication	Configures host authentication on specific ports using 802.1X	
Management IP Filter	Configures IP addresses that are allowed management access	

Table 5-26 Authentication Commands

5.12.1 User Account Commands

The basic commands required for management access are listed in this section. This switch also includes other options for password checking via the console or a Telnet connection (page 4-39), user authentication via a remote authentication server (page 4-83), and host access authentication for specific ports (page 4-118).

Command	Function	Mode
username	Establishes a user name-based authentication system at login	GC
enable password	Sets a password to control access to the Privileged Exec level	GC

Table 5-27 User Access Commands

username

This command adds named users, requires authentication at login, specifies or changes a user's password (or specify that no password is required), or specifies or changes a user's access level. Use the no form to remove a user name.

Syntax

username name {access-level level | nopassword | password {0 | 7} password} no username name

name - The name of the user. (Maximum length: 8 characters, case sensitive. Maximum users: 16)

access-level level - Specifies the user level.

The device has two predefined privilege levels:

0: Normal Exec, 15: Privileged Exec.

nopassword - No password is required for this user to log in.

{0 | 7} - 0 means plain password, 7 means encrypted password.

password password - The authentication password for the user. (Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

Default Setting

The default access level is Normal Exec.

The factory defaults for the user names and passwords are:

username	Access level	password
Guest	0	Guest
admin	15	admin

Table 5-28 Default Login Settings

Command Mode

Global Configuration

Command Usage

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

This **Example** shows how to set the access level and password for a user.

```
Console(config)#username bob access-level 15
Console(config)#username bob password 0 smith
Console(config)#
```

enable password

After initially logging onto the system, you should set the Privileged Exec password. Remember to record it in a safe place. This command controls access to the Privileged Exec level from the Normal Exec level. Use the no form to reset the default password.

Syntax

enable password [level level]{0 | 7} password

no enable password [level level]

level level - Level 15 for Privileged Exec. (Levels 0-14 are not used.)

{0 | 7} - 0 means plain password, 7 means encrypted password.

password - password for this privilege level. (Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

Default Setting

The default is level 15.

The default password is "super"

Command Mode

Global Configuration

Command Usage

You cannot set a null password. You will have to enter a password to change the

Command Mode

from Normal Exec to Privileged Exec with the enable command.

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

```
Console(config)# enable password level 15 0 admin
Console(config)#
```

Related Commands

enable

authentication enable

5.12.2 Authentication Sequence

Three authentication methods can be specified to authenticate users logging into the system for management access. The commands in this section can be used to define the authentication method and sequence.

Command	Function	Mode
authentication login	Defines logon authentication method and precedence	GC
authentication enable	Defines the authentication method and precedence for **Command Mode** change	GC

Table 5-29 Authentication Sequence

authentication login

This command defines the login authentication method and precedence. Use the no form to restore the default.

Syntax

authentication login {[local] [radius] [tacacs]} no authentication login

local - Use local password.

radius - Use RADIUS server password.

tacacs - Use TACACS server password.

Default Setting

Local

Command Mode

Global Configuration

Command Usage

RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.

You can specify three authentication methods in a single command to indicate the authentication sequence. For Example, if you enter "authentication login radius tacacs local," the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

Example

```
Console(config)#authentication login radius
Console(config)#
```

Related Commands

username - for setting the local user names and passwords

authentication enable

This command defines the authentication method and precedence to use when changing from Exec Command Mode to Privileged Exec command mode with the enable command (see page 4-10). Use the no form to restore the default.

Syntax

authentication enable {[local] [radius] [tacacs]}

no authentication enable

local - Use local password only.

radius - Use RADIUS server password only.

tacacs - Use TACACS server password.

Default Setting

Local

Command Mode

Global Configuration

Command Usage

RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.

You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter "authentication enable radius tacacs local," the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

Example

```
Console(config)#authentication enable radius
Console(config)#
```

Related Commands

enable password - sets the password for changing command modes

5.12.3 RADIUS Client

Remote Authentication Dial-in User Service (RADIUS) is a logon authentication protocol that uses software running on a central server to control access to RADIUS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Command	Function	Mode
radius-server host	Specifies the RADIUS server	GC
radius-server auth-port	Sets the RADIUS server authentication port	GC
radius-server acct-port	Sets the RADIUS server accounting port	GC

radius-server key	Sets the RADIUS encryption key	GC
radius-server retransmit	Sets the number of retries	GC
radius-server timeout	Sets the interval between sending authentication requests	GC
show radius-server	Shows the current RADIUS settings	PE

Table 5-30 RADIUS Client Commands

radius-server host

This command specifies primary and backup RADIUS servers and authentication parameters that apply to each server. Use the no form to restore the default values.

Syntax

[no] radius-server index host {host_ip_address} [auth-port auth_port] [acct-port acct_port] [timeout timeout] [retransmit retransmit] [key key]

index - Allows you to specify up to five servers. These servers are queried in sequence until a server responds or the retransmit period expires.

host_ip_address -IP address of server.

auth_port - RADIUS server UDP port used for authentication messages. (Range: 1-65535)

acct_port - RADIUS server UDP port used for accounting messages. (Range: 1-65535)

timeout - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

retransmit - Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1-30)

key -Encryption key used to authenticate logon access for client. Do not use blank spaces in the string. (Maximum length: 48 characters)

Default Setting

auth-port - 1812

acct-port - 1813

timeout - 5 seconds

retransmit - 2

Command Mode

Global Configuration

Example

```
Console(config)#radius-server 1 host 192.168.1.20 auth-port 181 timeout
10 retransmit 5 key green

Console(config)#
```

radius-server auth-port

This command sets the RADIUS server port used for authentication messages. Use the no form to restore the default.

Syntax

radius-server auth-port port_number no radius-server auth-port

port_number - RADIUS server UDP port used for authentication messages. (Range: 1-65535)

Default Setting

1812

Command Mode

Global Configuration

Example

```
Console(config)# radius-server auth-port 181
Console(config)#
```

radius-server acct-port

This command sets the RADIUS server port used for accounting messages. Use the no form to restore the default.

Syntax

radius-server acct-port port_number no radius-server acct-port

port_number -RADIUS server UDP port used for accounting messages. (Range: 1-65535)

Default Setting

1813

Command Mode

Global Configuration

Example

```
Console(config)# radius-server acct-port 8181
Console(config)#
```

radius-server key

This command sets the RADIUS encryption key. Use the no form to restore the default.

Syntax

radius-server key key_string no radius-server key

key_string - Encryption key used to authenticate logon access for client. Do not use blank spaces in the string. (Maximum

length: 48 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#radius-server key green
Console(config)#
```

radius-server retransmit

This command sets the number of retries. Use the no form to restore the default.

Syntax

radius-server retransmit number_of_retries no radius-server retransmit

number_of_retries -Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1-30)

Default Setting

2

Command Mode

Global Configuration

Example

```
Console(config)# radius-server retransmit 5
Console(config)#
```

radius-server timeout

This command sets the interval between transmitting authentication requests to the RADIUS server. Use the no form to restore the default.

Syntax

radius-server timeout number_of_seconds no radius-server timeout

number_of_seconds -Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

Default Setting

5

Command Mode

Global Configuration

Example

```
Console(config)#radius-server timeout 10
Console(config)#
```

show radius-server

This command displays the current settings for the RADIUS server.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show radius-server

Global Settings:
 Communication Key with RADIUS Server:
 Auth-Port:                                1812
 Acct-port:                               1813
 Retransmit Times:                         2
 Request Timeout:                          5

Server 1:
 Server IP Address:                       10.1.2.3
 Communication Key with RADIUS Server: ******
 Auth-Port:                                1812
 Acct-port:                               1813
 Retransmit Times:                         2
 Request Timeout:                         5

Radius server group:
Group Name                  Member Index

radius                      1
Console#
```

5.13.4 TACACS+ Client

Terminal Access Controller Access Control System (TACACS+) is a logon authentication protocol that uses software running on a central server to control access to TACACS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Command	Function	Mode
tacacs-server host	Specifies the TACACS+ server	GC
tacacs-server port	Specifies the TACACS+ server network port	GC
tacacs-server key	Sets the TACACS+ encryption key	GC
tacacs-server retransmit	Sets the number of retries	GC
tacacs-server timeout	Sets the interval before resending an authentication request	GC
show tacacs-server	Shows the current TACACS+ settings	GC

Table 5-31 TACACS+ Commands

tacacs-server host

This command specifies TACACS+ servers and parameters. Use the no form to restore the default.

Syntax

[no] tacacs-server index host {host_ip_address} [port port_number] [timeout timeout] [retransmit retransmit] [key key]

index - Specifies the index number of the server. (Range: 1)

host_ip_address -IP address of the server.

port_number -The TACACS+ server TCP port used for authentication messages. (Range: 1-65535)

timeout - Number of seconds the switch waits for a reply before resending a request. (Range: 1-540 seconds)

retransmit - Number of times the switch will resend an authentication request to the TACACS+ server. (Range: 1-30)

key -Encryption key used to authenticate logon access for client. Do not use blank spaces in the string. (Maximum length: 20 characters)

Default Setting

port - 49

timeout - 5 seconds

retransmit - 2

Command Mode

Global Configuration

Example

```
Console(config)# tacacs-server 1 host 192.168.1.25
Console(config)#
```

tacacs-server port

This command specifies the TACACS+ server network port. Use the no form to restore the default.

Syntax

tacacs-server port port_number no tacacs-server port

port_number - TACACS+ server TCP port used for authentication messages. (Range: 1-65535)

Default Setting

49

Command Mode

Global Configuration

Example

```
Console(config)# tacacs-server port 181
Console(config)#
```

tacacs-server key

This command sets the TACACS+ encryption key. Use the no form to restore the default.

Syntax

tacacs-server key key_string no tacacs-server key

key_string - Encryption key used to authenticate logon access for the

client. Do not use blank spaces in the string.

(Maximum length: 48 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)# tacacs-server key green
```

```
Console(config)#
```

tacacs-server retransmit

This command sets the number of retries. Use the no form to restore the default.

Syntax

tacacs-server retransmit number_of_retries no tacacs-server retransmit

number_of_retries -Number of times the switch will try to authenticate logon access via the TACACS+ server. (Range: 1-30)

Default Setting

2

Command Mode

Global Configuration

Example

```
Console(config)# tacacs-server retransmit 5
Console(config)#
```

tacacs-server timeout

This command sets the interval between transmitting authentication requests to the TACACS+ server. Use the no form to restore the default.

Syntax

tacacs-server timeout number_of_seconds no tacacs-server timeout

number_of_seconds -Number of seconds the switch waits for a reply before resending a request. (Range: 1-540)

Default Setting

5 seconds

Command Mode

Global Configuration

Example

```
Console(config)# tacacs-server timeout 10
Console(config)#
```

show tacacs-server

This command displays the current settings for the TACACS+ server.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show tacacs-server

Remote TACACS+ server configuration:

Global Settings:
  Communication Key with TACACS+ Server:
  Server Port Number:                    49
  Retransmit Times    :                  2
  Request Times    :                     5

Server 1:
  Server IP address:                   1.2.3.4
  Communication key with TACACS+ server: *****
  Server port number:                    49
  Retransmit Times    :                  2
  Request Times    :                     5

Tacacs server group:
Group Name                  Member Index
-----------------------------  ----------------
 tacacs+                            1
 Console#
```

5.12.5 AAA Commands

Authentication, Authorization, and Accounting (AAA) provides a framework for configuring access control on the Managed Switch. The AAA functions require the use of configured RADIUS or TACACS+ servers in the network.

Command	Function	Mode
aaa group server	Groups security servers in to defined lists	GC
server	Configures the IP address of a server in a group list	SG
aaa accounting dot1x	Enables accounting of 802.1X services	GC
aaa accounting exec	Enables accounting of Exec services	GC
aaa accounting commands	Enables accounting of Exec mode commands	GC
aaa accounting update	Enables periodoc updates to be sent to the accounting server	GC
accounting dot1x	Applies an accounting method to an interface for 802.1X service requests	IC
accounting exec	Applies an accounting method to local console, Telnet orSSH connections	Line
accounting commands	Applies an accounting method to CLI commands entered by a user	Line
aaa authorization exec	Enables authorization of Exec sessions	GC
authorization exec	Applies an authorization method to local console, Telnet orSSH connections	Line
show accounting	Displays all accounting information	PE

Table 5-32 AAA Commands

aaa group server

Use this command to name a group of security server hosts and enter Server Group Configuration mode for the specified group. To remove a server group from the configuration list, enter the no form of this command.

Syntax

[no] aaa group server {radius | tacacs+} group-name

radius -Defines a RADIUS server group.

tacacs+ -Defines a TACACS+ server group.

group-name -A text string that names a security server group. (Range: 1-7 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#
```

server

This command adds a security server to an AAA server group. Use the no form to remove the associated server from the group.

Syntax

[no] server {index | ip-address}

index - Specifies a server index and the sequence to use for the group. (Range: RADIUS 1-5, TACACS+ 1)

ip-address -Specifies the host IP address of a server.

Default Setting

None

Command Mode

Server Group Configuration

Command Usage

When specifying the index for a RADIUS server, that server index must already be defined by the radius-server host command (see page 4-88).

When specifying the index for a TACACS+ server, that server index must already be defined by the tacacs-server host command (see page 4-93).

Example

Specify the group name for a list of RADIUS servers, and then specify the server to add to the group

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#server 10.2.68.120
Console(config-sg-radius)#
```

aaa accounting dot1x

This command enables the accounting of requested 802.1X services for network connections. Use the no form to disable the accounting service.

Syntax

aaa accounting dot1x {default | method-name} start-stop group {radius | tacacs+ | server-group} no aaa accounting dot1x {default | method-name}

default - Specifies the default accounting method for service requests.

method-name -Specifies an accounting method for service requests. (Range: 1-255 characters)

start-stop - Records accounting from starting point and stopping point.

group -Specifies the server group to use. -radius - Specifies all RADIUS hosts configured with the radius-server host command described on page 4-88. -tacacs+ - Specifies all TACACS+ hosts configured with the tacacs-server host command described on page 4-93.

-server-group -Specifies the name of a server group configured with the aaa group server command described on 4-97. (Range: 1-255 characters)

Default Setting

Accounting is not enabled

No servers are specified

Command Mode

Global Configuration

Command Usage

Note that the default and method-name fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

Example

```
Console(config)# aaa accounting dot1x default start-stop group radius
Console(config)
```

aaa accounting exec

This command enables the accounting of requested Exec services for network connections. Use the no form to disable the accounting service.

Syntax

aaa accounting exec {default | method-name} start-stop group {radius | tacacs+ |server-group} no aaa accounting exec {default | method-name}

default - Specifies the default accounting method for service requests.

method-name - Specifies an accounting method for service requests. (Range: 1-255 characters)

start-stop - Records accounting from starting point and stopping point.

group -Specifies the server group to use. -radius -Specifies all RADIUS hosts configure with the radius-server host command described on page 4-88. -tacacs+ - Specifies all TACACS+ hosts configure with the tacacs-server host command described on page 4-93.

-server-group -Specifies the name of a server group configured with the aaa group server command described on 4-97. (Range: 1-255 characters)

Default Setting

Accounting is not enabled

No servers are specified

Command Mode

Global Configuration

Command Usage

This command runs accounting for Exec service requests for the local console and Telnet connections.

Note that the default and method-name fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

Example

```
Console(config)# aaa accounting exec default start-stop group tacacs+
Console(config)#
```

aaa accounting commands

This command enables the accounting of Exec mode commands. Use the no form to disable the accounting service.

Syntax

aaa accounting commands level {default | method-name} start-stop group {tacacs+ | server-group} no aaa accounting commands level {default | method-name} level -The privilege level for executed commands.

(Range: 0-15) default - Specifies the default accounting method for service requests.

method-name -Specifies an accounting method for service requests. (Range: 1-255 characters)

start-stop - Records accounting from starting point and stopping point.

group -Specifies the server group to use. -tacacs+ -Specifies all TACACS+ hosts configure with the tacacs-server host command described on page 4-93.

-server-group -Specifies the name of a server group configured with the aaa group server command described on 4-97. (Range: 1-255 characters)

Default Setting

Accounting is not enabled

No servers are specified

Command Mode

Global Configuration

Command Usage

The accounting of Exec mode commands is only supported by TACACS+ servers.

Note that the default and method-name fields are only used to describe the accounting method(s) configured on the specified TACACS+ server, and do not actually send any information to the server about the methods to use.

Example

```
Console(config)# aaa accounting commands 15 default start-stop group
tacacs+
Console(config)#
```

aaa accounting update

This command enables the sending of periodic updates to the accounting server. Use the no form to disable accounting updates.

Syntax

aaa accounting update [periodic interval] no aaa accounting update

interval -Sends an interim accounting record to the server at this interval. (Range: 1-2147483647 minutes)

Default Setting

1 minute

Command Mode

Global Configuration

Command Usage

When accounting updates are enabled, the switch issues periodic interim accounting records for all users on the system. Using the command without specifying an interim interval enables updates, but does not change the current interval setting.

Example

```
Console(config)# aaa accounting update periodic 30
Console(config)#
```

accounting dot1x

This command applies an accounting method for 802.1X service requests on an interface. Use the no form to disable accounting on the interface.

Syntax

accounting dot1x {default | list-name} no accounting dot1x default -Specifies the default method list created with the aaa accounting dot1x command (page 4-98).

list-name - Specifies a method list created with the aaa accounting dot1x command.

Default Setting

None

Command Mode

Interface Configuration

Example

```
Console(config)# interface ethernet 1/2
Console(config-if)# accounting dot1x tps
Console(config-if)#
```

accounting exec

This command applies an accounting method to local console or Telnet connections. Use the no form to disable accounting on the line.

Syntax

accounting exec {default | list-name} no accounting exec default -Specifies the default method list created with the aaa accounting exec command (page 4-99).

list-name - Specifies a method list created with the aaa accounting exec command.

Default Setting

None

Command Mode

Line Configuration

Example

```
Console(config)#line console
Console(config-line)#accounting exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#accounting exec default
Console(config-line)#
```

accounting commands

This command applies an accounting method to entered CLI commands. Use the no form to disable accounting for entered commands.

Syntax

accounting commands level {default | list-name} no accounting commands level

level -The privilege level for executing commands. (Range: 0-15)

default -Specifies the default method list created with the aaa accounting commands command (page 4-100).

list-name - Specifies a method list created with the aaa accounting commands command.

Default Setting

None

Command Mode

Line Configuration

Example

```
Console(config)#line console
Console(config-line)#accounting commands 15 default
Console(config-line)#
```

aaa authorization exec

This command enables the authorization for Exec access. Use the no form to disable the authorization service.

Syntax

aaa authorization exec {default | method-name} group {tacacs+ | server-group} no aaa authorization exec {default |

method-name} default - Specifies the default authorization method for Exec access.

method-name - Specifies an authorization method for Exec access. (Range: 1-255 characters)

group -Specifies the server group to use. -tacacs+ - Specifies all TACACS+ hosts configure with the tacacs-server host command described on page 4-93.

-server-group -Specifies the name of a server group configured with the aaa group server command described on 4-97. (Range: 1-255 characters)

Default Setting

Authorization is not enabled

No servers are specified

Command Mode

Global Configuration

Command Usage

This command performs authorization to determine if a user is allowed to run an Exec shell.

The user must be authenticated before AAA authorization is enabled.

If this command is issued without a specified named method, the default method list is applied to all interfaces or lines (where this authorization type applies), except those that have a named method explicitly defined.

Example

```
Console(config)# aaa authorization exec default group tacacs+
Console(config)#
```

authorization exec

This command applies an authorization method to local console or Telnet connections. Use the no form to disable authorization on the line.

Syntax

authorization exec {default | list-name} no authorization exec default - Specifies the default method list created with the aaa authorization exec command (page 4-103).

list-name - Specifies a method list created with the aaa authorization exec command.

Default Setting

None

Command Mode

Line Configuration

Example

```
Console(config)#line console
Console(config-line)#authorization exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#authorization exec default
Console(config-line)#
```

show accounting

This command displays the current accounting settings per function and per port.

Syntax

show accounting [commands [level] | [dot1x [statistics [username user-name | interface]] | exec [statistics] | statistics]

commands - Displays accounting information for CLI commands entered at the specified privilege level.

level -The CLI command privilege level. (Range: 0-15)

dot1x - Displays dot1x accounting information.

exec -Displays Exec accounting records.

statistics - Displays accounting records.

user-name -Displays accounting records for a specifiable username.

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show accounting

Accounting type: dot1x
   Method list: default
   Group list: radius
   Interface:

   Method list: tps
   Group list: radius
   Interface: eth 1/2

Accounting type: Exec
   Method list: default
   Group list: radius
   Interface: vty

Console#
```

5.12.6 Web Server Commands

This section describes commands used to configure web browser management access to the Managed Switch.

Command	Function	Mode
ip http port	Specifies the port to be used by the web browser interface	GC
ip http server	Allows the switch to be monitored or configured from a browser	GC
ip http secure-server	Enables HTTPS for encrypted communications	GC
ip http secure-port	Specifies the UDP port number for HTTPS	GC

Table 5-33 Web Server Commands

ip http port

This command specifies the TCP port number used by the web browser interface. Use the no form to use the default port.

Syntax

ip http port port-number no ip http port

port-number -The TCP port to be used by the browser interface. (Range: 1-65535)

Default Setting

80

Command Mode

Global Configuration

Example

```
Console(config)# ip http port 769
Console(config)#
```

Related Commands

ip http server

ip http server

This command allows this device to be monitored or configured from a browser. Use the no form to disable this function.

Syntax

[no] ip http server

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#ip http server
Console(config)#
```

Related Commands

Ip http port

ip http secure-server

This command enables the secure hypertext transfer protocol (HTTPS) over the Secure Socket Layer (SSL), providing secure access (i.e., an encrypted connection) to the switch's web interface. Use the no form to disable this function.

Syntax

[no] ip http secure-server

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

Both HTTP and HTTPS service can be enabled independently on the switch. However, you cannot configure the HTTP and HTTPS servers to use the same UDP port.

If you enable HTTPS, you must indicate this in the URL that you specify in your browser: https://device[:port_number]

- When you start HTTPS, the connection is established in this way: -The client authenticates the server using the server's digital certificate. -The client and server negotiate a set of security protocols to use for the connection. -The client and server generate session keys for encrypting and decrypting data.

The client and server establish a secure encrypted connection. A padlock icon should appear in the status bar for Internet Explorer 5.x or above, Netscape 6.2 or above, and Mozilla Firefox 2.0.0.0 or above.

The following web browsers and operating systems currently support HTTPS:

To specify a secure-site certificate, see "Replacing the Default Secure-site Certificate" on page 3-74. Also refer to the copy command on page 4-34.

Web Browser	Operating System
Internet Explorer 5.0 or later	Windows 98,Windows NT (with service pack 6a), Windows 2000, Windows XP
Netscape 6.2 or later	Windows 98,Windows NT (with service pack 6a), Windows 2000, Windows XP, Solaris 2.6
Mozilla Firefox 2.0.0.0 or later	Windows 2000, Windows XP, Linux

Table 5-34 HTTPS System Support

Example

```
Console(config)# ip http secure-server
Console(config)#
```

Related Commands

ip http secure-port

copy tftp https-certificate

ip http secure-port

This command specifies the UDP port number used for HTTPS/SSL connection to the switch's web interface. Use the no form to restore the default port.

Syntax

ip http secure-port port_number no ip http secure-port

port_number – The UDP port used for HTTPS/SSL.

(Range: 1-65535)

Default Setting

443

Command Mode

Global Configuration

Command Usage

You cannot configure the HTTP and HTTPS servers to use the same port.

If you change the HTTPS port number, clients attempting to connect to the HTTPS server must specify the port number in the URL, in this format:

https://device:port_number

Example

```
Console(config)# ip http secure-port 1000
Console(config)#
```

Related Commands

ip http secure-server

5.12.7 Telnet Server Commands

Command	Function	Mode
ip telnet server	Allows the switch to be monitored or configured from Telnet; alsospecifies the port to be used by the Telnet interface	GC

Table 5-35 Telnet Server Commands

ip telnet server

This command allows this device to be monitored or configured from Telnet. It also specifies the TCP port number used by the Telnet interface. Use the no form without the "port" keyword to disable this function. Use the no from with the "port" keyword to use the default port.

Syntax

ip telnet server [port port-number]

no telnet server [port]

port -The TCP port used by the Telnet interface.

port-number -The TCP port number to be used by the browser interface. (Range: 1-65535)

Default Setting

Server: Enabled

Server Port: 23

Command Mode

Global Configuration

Example

```
Console(config)#ip telnet server
Console(config)#ip telnet port 123
```

```
Console(config)#
```

5.12.8 Secure Shell Commands

This section describes the commands used to configure the SSH server. However, note that you also need to install a SSH client on the management station when using this protocol to configure the switch.

The Managed Switch supports both SSH Version 1.5 and 2.0.

Command	Function	Mode
ip ssh server	Enables the SSH server on the switch	GC
ip ssh timeout	Specifies the authentication timeout for the SSH server	GC
ip ssh authentication-retries	Specifies the number of retries allowed by a client	GC
ip ssh server-key size	Sets the SSH server key size	GC
copy tftp public-key	Copies the user's public key from a TFTP server to the switch	PE
delete public-key	Deletes the public key for the specified user	PE
ip ssh crypto host-key generate	Generates the host key	PE
ip ssh crypto zeroize	Clear the host key from RAM	PE
ip ssh save host-key	Saves the host key from RAM to flash memory	PE
disconnect	Terminates a line connection	PE
show ip ssh	Displays the status of the SSH server and the configured valuesfor authentication timeout and retries	PE
show ssh	Displays the status of current SSH sessions	PE
show public-key	Shows the public key for the specified user or for the host	PE
show users	Shows SSH users, including privilege level and public key type	PE

Table 5-36 Secure Shell Commands

Configuration Guidelines

The SSH server on this Managed Switch supports both password and public key authentication. If password authentication is specified by the SSH client, then the password can be authenticated either locally or via a RADIUS or TACACS+ remote authentication server, as specified by the authentication login command. If public key authentication is specified by the client, then you must configure authentication keys on both the client and the Managed Switch as described in the following section. Note that regardless of whether you use public key or password authentication, you still have to generate authentication keys on the Managed Switch and enable the SSH server.

To use the SSH server, complete these steps:

1. Generate a Host Key Pair – Use the ip ssh crypto host-key generate command to create a host public/private key pair.

2. Provide Host Public Key to Clients – Many SSH client programs automatically import the host public key during the initial connection setup with the switch. Otherwise, you need to manually create a known hosts file on the management station and place the host public key in it. An entry for a public key in the known hosts file would appear similar to the following example:

   10.1.0.54 1024 35 156849954018676692593339467750546173253136748908365472541502024559319986854435836165199992332978176606583095610825913212890233765468017262725714134287629413011961955667825956641048695742788814620651941746772984865468615717739390164779355942303577413098022737087794545240839717526463580581767167097574804776117

3. Import Client's Public Key to the Switch – Use the copy tftp public-key command to copy a file containing the public key for all the SSH client's granted management access to the switch. (Note that these clients must be configured locally on the switch via the User Accounts page as described.) The clients are subsequently authenticated using these keys. The current firmware only accepts public key files based on standard UNIX format as shown in the following example for an RSA Version 1 key:

   1024 35 134108168560989392104094492015542534763164192187295892114317388005553616163105177594083868631109291232226828519254374603100937187721996963178136627741416898513204911720483033925432410163799759237144901193800609025394840848271781943722884025331159521348610229029789827213532671316294325328189150453063939166433 steve@192.168.1.19

4. Set the Optional Parameters – Set other optional parameters, including the authentication timeout, the number of retries, and the server key size.

5. Enable SSH Service – Use the **ip ssh server** command to enable the SSH server on the switch.

6. Authentication – One of the following authentication methods is employed: Password Authentication (for SSH v1.5 or V2 Clients)

   a. The client sends its password to the server.
   b. The switch compares the client's password to those stored in memory.
   c. If a match is found, the connection is allowed.

To use SSH with only password authentication, the host public key must still be given to the client, either during initial connection or manually entered into the known host file. However, you do not need to configure the client's keys.

Public Key Authentication – When an SSH client attempts to contact the switch, the SSH server uses the host key pair to negotiate a session key and encryption method. Only clients that have a private key corresponding to the public keys stored on the switch can access it. The following exchanges take place during this process:

Authenticating SSH v1.5 Clients

a. The client sends its RSA public key to the switch.
b. The switch compares the client's public key to those stored in memory.
c. If a match is found, the switch uses its secret key to generate a random 256-bit string as a challenge, encrypts this string with the user's public key, and sends it to the client.
d. The client uses its private key to decrypt the challenge string, computes the MD5 checksum, and sends the checksum back to the switch.
e. The switch compares the checksum sent from the client against that computed for the original string it sent. If the two checksums match, this means that the client's private key corresponds to an authorized public key, and the client is authenticated.

Authenticating SSH v2 Clients

a. The client first queries the switch to determine if DSA public key authentication using a preferred algorithm is acceptable.
b. If the specified algorithm is supported by the switch, it notifies the client to proceed with the authentication process. Otherwise, it rejects the request.
c. The client sends a signature generated using the private key to the switch.
d. When the server receives this message, it checks whether the supplied key is acceptable for authentication, and if so, it then checks whether the signature is correct. If both checks succeed, the client is authenticated.

The SSH server supports up to four client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

ip ssh server

This command enables the Secure Shell (SSH) server on this switch. Use the no form to disable this service.

Syntax

[no] ip ssh server

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The SSH server supports up to four client sessions. The maximum number of client sessions includes both current Telnet

sessions and SSH sessions.

The SSH server uses DSA or RSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either DES (56-bit) or 3DES (168-bit) for data encryption.

You must generate DSA and RSA host keys before enabling the SSH server.

Example

```
Console# ip ssh crypto host-key generate
Console#configure
Console(config)#ip ssh server
Console(config)#
```

Related Commands

ip ssh crypto host-key generate

show ssh

ip ssh timeout

This command configures the timeout for the SSH server. Use the no form to restore the default setting.

Syntax

ip ssh timeout seconds no ip ssh timeout seconds – The timeout for client response during SSH negotiation. (Range: 1-120)

Default Setting

10 seconds

Command Mode

Global Configuration

Command Usage

The timeout specifies the interval the switch will wait for a response from the client during the SSH negotiation phase. Once an SSH session has been established, the timeout for user input is controlled by the exec-timeout command for vty sessions.

Example

```
Console(config)#ip ssh timeout 60
Console(config)#
```

Related Commands

exec-timeout

show ip ssh

ip ssh authentication-retries

This command configures the number of times the SSH server attempts to reauthenticate a user. Use the no form to restore the default setting.

Syntax

ip ssh authentication-retries count no ip ssh authentication-retries count – The number of authentication attempts permitted after which the interface is reset. (Range: 1-5)

Default Setting

3

Command Mode

Global Configuration

Example

```
Console(config)#ip ssh authentication-retires 2
Console(config)#
```

Related Commands

show ip ssh

ip ssh server-key size

This command sets the SSH server key size. Use the no form to restore the default setting.

Syntax

ip ssh server-key size key-size no ip ssh server-key size

key-size – The size of server key. (Range: 512-896 bits)

Default Setting

768 bits

Command Mode

Global Configuration

Command Usage

The server key is a private key that is never shared outside the switch.

The host key is shared with the SSH client, and is fixed at 1024 bits.

Example

```
Console(config)#ip ssh server-key size 512
Console(config)#
```

delete public-key

This command deletes the specified user's public key.

Syntax

delete public-key username [dsa | rsa]

username – Name of an SSH user. (Range: 1-8 characters)

dsa – DSA public key type.

rsa – RSA public key type.

Default Setting

Deletes both the DSA and RSA key.

Command Mode

Privileged Exec

Example

```
Console#delete public-key admin dsa
Console#
```

ip ssh crypto host-key generate

This command generates the host key pair (i.e., public and private).

Syntax

ip ssh crypto host-key generate [dsa | rsa]

dsa – DSA (Version 2) key type.

rsa – RSA (Version 1) key type.

Default Setting

Generates both the DSA and RSA key pairs.

Command Mode

Privileged Exec

Command Usage

This command stores the host key pair in memory (i.e., RAM). Use the ip ssh save host-key command to save the host key pair to flash memory.

Some SSH client programs automatically add the public key to the known hosts file as part of the configuration process.

Otherwise, you must manually create a known hosts file and place the host public key in it.

The SSH server uses this host key to negotiate a session key and encryption method with the client trying to connect to it.

Example

```
Console# ip ssh crypto host-key generate dsa
Console#
```

Related Commands

ip ssh crypto zeroize

ip ssh save host-key

ip ssh crypto zeroize

This command clears the host key from memory (i.e. RAM).

Syntax

ip ssh crypto zeroize [dsa | rsa]

dsa – DSA key type.

rsa – RSA key type.

Default Setting

Clears both the DSA and RSA key.

Command Mode

Privileged Exec

Command Usage

This command clears the host key from volatile memory (RAM). Use the no ip ssh save host-key command to clear the host key from flash memory.

The SSH server must be disabled before you can execute this command.

Example

```
Console# ip ssh crypto zeroize dsa
Console#
```

Related Commands

ip ssh crypto host-key generate

ip ssh save host-key

no ip ssh server

ip ssh save host-key

This command saves host key from RAM to flash memory.

Syntax

ip ssh save host-key [dsa | rsa]

dsa – DSA key type.

rsa – RSA key type.

Default Setting

Saves both the DSA and RSA key.

Command Mode

Privileged Exec

Example

```
Console#ip ssh save host-key dsa
Console#
```

Related Commands

ip ssh crypto host-key generate

show ip ssh

This command displays the connection settings used when authenticating client access to the SSH server.

Command Mode

Privileged Exec

Example

```
Console#show ip ssh
SSH Enabled - version 1.99
Negotiation timeout: 120 secs; Authentication retries: 3
Server key size: 768 bits
Console#
```

show ssh

This command displays the current SSH server connections.

Command Mode

Privileged Exec

Example

```
Console# show ssh
Connection Version State              Username    Encryption
 0         2.0     Session-Started    admin       ctos aes128-cbc-hmac-md5
                                                  stoc aes128-cbc-hmac-md5
Console#
```

Field	Description
Session	The session number. (Range: 0-3)
Version	The Secure Shell version number.
State	The authentication negotiation state. (Values: Negotiation-Started, Authentication-Started, Session-Started)
Username	The user name of the client.

Table 5-37 show ssh - display description

Field	Description
Encryption	The encryption method is automatically negotiated between the client and server. Options for SSHv1.5 include: DES, 3DES Options for SSHv2.0 can include different algorithms for the client-to-server (ctos) and server-to-client (stoc): aes128-cbc-hmac-sha1 aes192-cbc-hmac-sha1 aes256-cbc-hmac-sha1 3des-cbc-hmac-sha1 blowfish-cbc-hmac-sha1 aes128-cbc-hmac-md5 aes192-cbc-hmac-md5 aes256-cbc-hmac-md5

	3des-cbc-hmac-md5 blowfish-cbc-hmac-md5 **Terminology:** DES – Data Encryption Standard (56-bit key) 3DES – Triple-DES (Uses three iterations of DES, 112-bit key) aes – Advanced Encryption Standard (160 or 224-bit key) blowfish – Blowfish (32-448 bit key) cbc – cypher-block chaining sha1 – Secure Hash Algorithm 1 (160-bit hashes) md5 – Message Digest algorithm number 5 (128-bit hashes)

show public-key

This command shows the public key for the specified user or for the host.

Syntax

show public-key [user [username]| host]

username – Name of an SSH user. (Range: 1-8 characters)

Default Setting

Shows all public keys.

Command Mode

Privileged Exec

Command Usage

- If no parameters are entered, all keys are displayed. If the user keyword is entered, but no user name is specified, then the public keys for all users are displayed.
- When an RSA key is displayed, the first field indicates the size of the host key (e.g., 1024), the second field is the encoded public exponent (e.g., 35), and the last string is the encoded modulus. When a DSA key is displayed, the first field indicates that the encryption method used by SSH is based on the Digital Signature Standard (DSS), and the last string is the encoded modulus.

Example

```
Console#show public-key host
Host:
RSA:
1024 35
156849954018676692593339467750546173253136748908365472541502024559319986 8
```

```
544358361651999923329781766065830958610825913212890233765468017262725714134287629413011961955667825956641048695742788814620651941746772984865468615717739390164779355942303577413098022737087794545240839717526463580581767167095748047761170
DSA:
ssh-dss AAAB3NzaC1kc3MAAACBAPWKZTPbsRIB8ydEXcxM3dyV/yrDbKStllnzD/Dg0h2HxcYV44sXZ2JXhamLK6P8bvuiyacWbUW/a4PAtp1KMSdqsKeh3hKoA3vRRSy1N2XFfAKxl5fwFfvJlPdOkFgzLGMinvSNYQwiQXbKTBH0Z4mUZpE85PWxDZMaCNBPjBrRAAAAFQChb4vsdfQGNIjwbvwrNLaQ77isiwAAAIEAsy5YWDC99ebYHNRj5kh47wY4i8cZvH+/p9cnrfwFTMU01VFDly3IR2G395NLy5Qd7ZDxfA9mCOfT/yyEfbobMJZi8oGCstSNOxrZZVnMqWrTYfdrKX7YKBw/Kjw6BmiFq7O+jAhf1Dg45loAc27s6TLdtny1wRq/ow2eTCD5nekAAACBAJ8rMccXTxHLFAczWS7EjOyDbsloBfPuSAb4oAsyjKXKVYNLQkTLZfcFRu41bS2KV5LAwecsigF/+DjKGWtPNIQqabKgYCw2o/dVzX4Gg+yqdTlYmGA7fHGm8ARGeiG4ssFKy4Z6DmYPXFum1Yg0fhLwuHpOSKdxT3kk475S7w0W
Console#
```

5.12.9 802.1X Port Authentication

The Managed Switch supports IEEE 802.1X (dot1x) port-based access control that prevents unauthorized access to the network by requiring users to first submit credentials for authentication. Client authentication is controlled centrally by a RADIUS server using EAP (Extensible Authentication Protocol).

Command	Function	Mode
dot1x system-auth-control	Enables dot1x globally on the switch.	GC
dot1x default	Resets all dot1x parameters to their default values	GC
dot1x max-req	Sets the maximum number of times that the switch retransmits an EAP request/identity packet to the client before it times out the authentication session	IC
dot1x port-control	Sets dot1x mode for a port interface	IC
dot1x operation-mode	Allows single or multiple hosts on an dot1x port	IC
dot1x re-authenticate	Forces re-authentication on specific ports	PE
dot1x re-authentication	Enables re-authentication for all ports	IC
dot1x timeout quiet-period	Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client	IC
dot1x timeout re-authperiod	Sets the time period after which a connected client must be re-authenticated	IC

dot1x timeout tx-period	Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet	IC
dot1x intrusion-action	Sets the port response to intrusion when authentication fails	IC
show dot1x	Shows all dot1x related information	PE

Table 5-38 802.1X Port Authentication Commands

dot1x system-auth-control

This command enables 802.1X port authentication globally on the switch. Use the no form to restore the default.

Syntax

[no] dotx system-auth-control

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dot1x system-auth-control
Console(config)#
```

dot1x default

This command sets all configurable dot1x global and port settings to their default values.

Command Mode

Global Configuration

Example

```
Console(config)#dot1x default
Console(config)#
```

dot1x max-req

This command sets the maximum number of times the switch port will retransmit an EAP request/identity packet to the client before it times out the authentication session. Use the no form to restore the default.

Syntax

dot1x max-req count

no dot1x max-req

count – The maximum number of requests (Range: 1-10)

Default

2

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-req 2
Console(config-if)
```

dot1x port-control

This command sets the dot1x mode on a port interface. Use the no form to restore the default.

Syntax

dot1x port-control {auto | force-authorized | force-unauthorized} no dot1x port-control auto – Requires a dot1x-aware connected client to be authorized by the RADIUS server. Clients that are not dot1x-aware will be denied access.

force-authorized – Configures the port to grant access to all clients, either dot1x-aware or otherwise.

force-unauthorized – Configures the port to deny access to all clients, either dot1x-aware or otherwise.

Default

force-authorized

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x port-control auto
Console(config-if)#
```

dot1x operation-mode

This command allows single or multiple hosts (clients) to connect to an 802.1X-authorized port. Use the no form with no keywords to restore the default to single host. Use the no form with the multi-host max-count keywords to restore the default maximum count.

Syntax

dot1x operation-mode {single-host | multi-host [max-count count]}

no dot1x operation-mode [multi-host max-count]

single-host – Allows only a single host to connect to this port.

multi-host – Allows multiple host to connect to this port.

max-count – Keyword for the maximum number of hosts. count – The maximum number of hosts that can connect to a port. (Range: 1-1024; Default: 5)

Default

Single-host

Command Mode

Interface Configuration

Command Usage

The "max-count" parameter specified by this command is only effective if the dot1x mode is set to "auto" by the dot1x port-control command (page 4-120).

In "multi-host" mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x operation-mode multi-host max-count 10
Console(config-if)#
```

dot1x re-authenticate

This command forces re-authentication on all ports or a specific interface.

Syntax

dot1x re-authenticate [interface] interface

• ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

Command Mode

Privileged Exec

Command Usage

The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During -authentication, the client remains connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked or the user assigned to the Guest VLAN (see dot1x

intrusion-action on page 4-124).

Example

```
Console#dot1x re-authenticate
Console#
```

dot1x re-authentication

This command enables periodic re-authentication globally for all ports. Use the no form to disable re-authentication.

Syntax

[no] dot1x re-authentication

Command Mode

Interface Configuration

Command Usage

The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During re-authentication, the client remains connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked or the user assigned to the Guest VLAN (see dot1x intrusion-action on page 4-124).

The connected client is re-authenticated after the interval specified by the dot1x timeout re-authperiod command. The default is 3600 seconds.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x re-authentication
Console(config-if)#
```

Related Commands

dot1x timeout re-authperiod

dot1x timeout quiet-period

This command sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client. Use the no form to reset the default.

Syntax

dot1x timeout quiet-period seconds

no dot1x timeout quiet-period

seconds -The number of seconds. (Range: 1-65535)

Default

60 seconds

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout quiet-period 350
Console(config-if)#
```

dot1x timeout re-authperiod

This command sets the time period after which a connected client must be re-authenticated.

Syntax

dot1x timeout re-authperiod seconds

no dot1x timeout re-authperiod

seconds -The number of seconds. (Range: 1-65535)

Default

3600 seconds

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout re-authperiod 300
Console(config-if)#
```

dot1x timeout tx-period

This command sets the time that an interface on the switch waits during an authentication session before re-transmitting an EAP packet. Use the no form to reset to the default value.

Syntax

dot1x timeout tx-period seconds

no dot1x timeout tx-period

seconds -The number of seconds. (Range: 1-65535)

Default

30 seconds

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout tx-period 300
Console(config-if)#
```

dot1x intrusion-action

This command sets the port's response to a failed authentication, either to block all traffic, or to assign all traffic for the port to a guest VLAN. Use the no form to reset the default.

Syntax

dot1x intrusion-action {block-traffic | guest-vlan} no dot1x intrusion-action

block-traffic - Blocks traffic on this port.

guest-vlan - Assigns the user to the Guest VLAN.

Default

block-traffic

Command Mode

Interface Configuration

Command Usage

For guest VLAN assignment to be successful, the VLAN must be configured and set as active (see "**vlan database**") and assigned as the guest VLAN for the port (see "**network-access guest-vlan**").

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x intrusion-action guest-vlan
Console(config-if)#
```

show dot1x

This command shows general port authentication related settings on the switch or a specific interface.

Syntax

show dot1x [statistics] [interface interface]

statistics - Displays dot1x status for each port.

interface ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-26)

Command Mode

Privileged Exec

Command Usage

This command displays the following information:

- ***Global 802.1X Parameters*** – Shows whether or not 802.1X port authentication is globally enabled on the Managed Switch.
- ***802.1X Port Summary*** – Displays the port access control parameters for each interface, including the following items:

-Status	– Administrative state for port access control.
-Operation Mode	– Dot1x port control operation mode.
-Mode	– Dot1x port control mode.
-Authorized	– Authorization status (yes or n/a - not authorized).

- ***802.1X Port Details*** – Displays the port access control parameters for each interface, including the following items:

-reauth-enabled	- Periodic re-authentication.
-reauth-period	- Time after which a connected client must be re-authenticated
-quiet-period	- Time a port waits after Max Request Count is exceeded before attempting to acquire a new client
-tx-period	- Time a port waits during authentication session before re-transmitting EAP packet.
-supplicant-timeout	- Supplicant timeout.
-server-timeout	- Server timeout.
-reauth-max	- Maximum number of reauthentication attempts.
-max-req	- Maximum number of times a port will retransmit an EAP request/identity packet to the client before it times out the authentication session
-Status	- Authorization status (authorized or not). -Operation Mode – Shows if single or multiple hosts (clients) can connect to an 802.1X-authorized port.
-Max Count	- The maximum number of hosts allowed to access this port

-Port-control - Shows the dot1x mode on a port as auto, force-authorized, or force-unauthorized.

-Supplicant - MAC address of authorized client. -Current Identifier – The integer (0-255) used by the Authenticator to identify the current authentication session.

-Intrusion action - Shows whether the switch will block all traffic or assign traffic on the port to a guest VLAN if authentication fails.

- ***Authenticator State Machine***

- State - Current state (including initialize, disconnected, connecting, authenticating, authenticated, aborting, held, force_authorized, force_unauthorized).

-Reauth Count - Number of times connecting state is re-entered.

- ***Backend State Machine***

-State - Current state (including request, response, success, fail, timeout, idle, initialize).

-Request Count - Number of EAP Request packets sent to the Supplicant without receiving a response.

- Identifier(Server) - Identifier carried in the most recent EAP Success, Failure or Request packet received from the Authentication Server.

- ***Reauthentication State Machine***

-State - Current state (including initialize, reauthenticate).

Example

```
Console# show dot1x
Global 802.1X Parameters
   system-auth-control: enable
802.1X Port Summary
Port Name    Status     Operation Mode    Mode              Authorized
1/1          disabled   Single-Host       ForceAuthorized   n/a
1/2          enabled    Single-Host       auto              yes

1/28         disabled   Single-Host       ForceAuthorized   n/a
802.1X Port Details
802.1X is disabled on port 1/1
802.1X is enabled on port 1/2
```

```
reauth-enabled:                 Enable
reauth-period:                  1800
quiet-period:                   30
tx-period:                      40
supplicant-timeout:             30
server-timeout:                 10
reauth-max:                     2
max-req:                        5
Status                          Authorized
Operation mode                  Single-Host
Max count                       5
Port-control                    Auto
Supplicant    Current           00-30-4F-49-5e-dc
Identifier                      3
Intrusion action                Guest VLAN
Authenticator State Machine
State                           Authenticated
Reauth Count                    0
Backend State Machine
State                           Idle
Request Count                   0
Identifier(Server)              2
Reauthentication State Machine
State                           Initialize
```

5.12.10 Management IP Filter Commands

This section describes commands used to configure IP management access to the switch

Command	Function	Mode
management	Configures IP addresses that are allowed management access	GC
show management	Displays the switch to be monitored or configured from a browser	PE

Table 5-39 IP Filter Commands

management

This command specifies the client IP addresses that are allowed management access to the switch through various protocols. Use the no form to restore the default setting.

Syntax

[no] management {all-client | http-client | snmp-client | telnet-client} start-address [end-address]

all-client -Adds IP address(es) to the SNMP, web and Telnet groups.

http-client -Adds IP address(es) to the web group.

snmp-client -Adds IP address(es) to the SNMP group.

telnet-client -Adds IP address(es) to the Telnet group.

start-address - A single IP address, or the starting address of a range.

end-address -The end address of a range.

Default Setting

All addresses

Command Mode

Global Configuration

Command Usage

- If anyone tries to access a management interface on the switch from an invalid address, the switch will reject the connection, enter an event message in the system log, and send a trap message to the trap manager.
- IP address can be configured for SNMP, web and Telnet access respectively. Each of these groups can include up to five different sets of addresses, either individual addresses or address ranges.
- When entering addresses for the same group (i.e., SNMP, web or Telnet), the switch will not accept overlapping address ranges. When entering addresses for different groups, the switch will accept overlapping address ranges.
- You cannot delete an individual address from a specified range. You must delete the entire range, and reenter the addresses.
- You can delete an address range just by specifying the start address, or by specifying both the start address and end address.

Example

This **Example** restricts management access to the indicated addresses.

```
Console(config)#management all-client 192.168.1.19
Console(config)#management all-client 192.168.1.25 192.168.1.30
Console(config)#
```

show management

This command displays the client IP addresses that are allowed management access to the switch through various protocols.

Syntax

show management {all-client | http-client | snmp-client | telnet-client}

all-client -Adds IP address(es) to the SNMP, web and Telnet groups.

http-client -Adds IP address(es) to the web group.

snmp-client -Adds IP address(es) to the SNMP group.

telnet-client -Adds IP address(es) to the Telnet group.

Command Mode

Privileged Exec

Example

```
Console# show management all-client
Management IP Filter
 HTTP-Client:
   Start IP address      End IP address
 192.168.1.19          192.168.1.19
 192.168.1.25          192.168.1.30

 SNMP-Client:
   Start IP address      End IP address
 192.168.1.19          192.168.1.19
 192.168.1.25          192.168.1.30

 TELNET-Client:
   Start IP address      End IP address
 192.168.1.19          192.168.1.19
 192.168.1.25          192.168.1.30

Console#
```

5.13 Client Security Commands

This switch supports many methods of segregating traffic for clients attached to each of the data ports, and for ensuring that only authorized clients gain access to the network. Private VLANs and port-based authentication using IEEE 802.1X are commonly used for these purposes. In addition to these methods, several other options of providing client security are described in this section. These include port-based authentication, which can be configured to allow network client access by specifying a fixed set of MAC addresses. The addresses assigned to DHCP clients can also be carefully controlled using static or dynamic bindings with the IP Source Guard and DHCP Snooping commands.

Table 4-40 Client Security Commands

Command Group	Function
Private VLANs	Configures private VLANs, including uplink and downlink ports
Port Security*	Configures secure addresses for a port
Port Authentication*	Configures host authentication on specific ports using 802.1X
Network Access*	Configures MAC authentication and dynamic VLAN assignment
Web Authentication*	Configures Web authentication
Access Control Lists*	Provides filtering for IP frames (based on address, protocol, TCP/UDP port number or TCP control code) or non-IP frames (based on MAC address or Ethernet type)

DHCP Snooping*	Filters untrusted DHCP messages on unsecure ports by buildingand maintaining a DHCP snooping binding table
IP Source Guard*	Filters IP traffic on unsecure ports for which the source address cannot be identified via DHCP snooping nor static source bindings

* The priority of execution for these filtering commands is Port Security, Port Authentication, Network Access, Web Authentication, Access Control Lists, DHCP Snooping, and then IP Source Guard.

5.13.1 Port Security Commands

These commands can be used to enable port security on a port. When using port security, the switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table for this port will be authorized to access the network. The port will drop any incoming frames with a source MAC address that is unknown or has been previously learned from another port. If a device with an unauthorized MAC address attempts to use the switch port, the intrusion will be detected and the switch can automatically take action by disabling the port and sending a trap message.

Command	Function	Mode
port security	Configures a secure port	IC
mac-address-table static	Maps a static address to a port in a VLAN	GC
show mac-address-table	Displays entries in the bridge-forwarding database	PE

Table 5-41 Port Security Commands

port security

This command enables or configures port security. Use the no form without any keywords to disable port security. Use the no form with the appropriate keyword to restore the default settings for a response to security violation or for the maximum number of allowed addresses.

Syntax

port security [action {shutdown | trap | trap-and-shutdown} | max-mac-count address-count] no port security [action | max-mac-count] action -Response to take when port security is violated. -shutdown - Disable port only. -trap - Issue SNMP trap message only. -trap-and-shutdown - Issue SNMP trap message and disable port. max-mac-count -address-count - The maximum number of MAC addresses that can be learned on a port. (Range: 0-1024)

Default Setting

Status: Disabled

Action: None

Maximum Addresses: 0

Command Mode

Interface Configuration (Ethernet)

Command Usage

If you enable port security, the switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table will be accepted.

Use the port security command to enable security on a port. Then use the port security action command to set the response to a port security violation, and the port security max-mac-count command to set the maximum number of addresses allowed on a port.

You can also manually add secure addresses with the mac-address-table static command.

A secure port has the following restrictions:

-Cannot be connected to a network interconnection device.

-Cannot be a trunk port.

If a port is disabled due to a security violation, it must be manually re-enabled using the no shutdown command.

Example

The following **Example** enables port security for port 5, and sets the response to a security violation to issue a trap message:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port security
Console(config-if)#port security action trap
Console(config-if)#
```

Related Commands

shutdown

mac-address-table static

show mac-address-table

5.13.2 Network Access (MAC Address Authentication)

Network Access authentication controls access to the network by authenticating the MAC address of each host that attempts to connect to a switch port. Traffic received from a specific MAC address is forwarded by the switch only if the source MAC address is successfully authenticated by a central RADIUS server. While authentication for a MAC address is in progress, all traffic is blocked until authentication is completed. Once successfully authenticated, the RADIUS server may optionally assign VLAN settings for the switch port.

Command	Function	Mode
network-access mode	Enables MAC authentication on an interface	IC

network-access max-mac-count	Sets a maximum for authenticated MAC addresses on an interface	IC
mac-authentication intrusion-action	Determines the port response when a connected host fails MAC authentication.	IC
mac-authentication max-mac-count	Sets a maximum for mac-authentication autenticated MAC addresses on an interface	IC
network-access dynamic-vlan	Enables dynamic VLAN assignment from a RADIUS server	IC
network-access guest-vlan	Specifies the guest VLAN	IC
mac-authentication reauth-time	Sets the time period after which a connected MACaddress must be re-authenticated	GC
clear network-access	Clears authenticated MAC addresses from the address table	PE
show network-access	Displays the MAC authentication settings for port interfaces	PE
show network-access mac-address-table	Displays information for entries in the secure MAC address table	PE

Table 5-42 Network Access

network-access mode

Use this command to enable network access authentication on a port. Use the no form of this command to disable network access authentication.

Syntax

[no] network-access mode mac-authentication

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

When enabled on a port, the authentication process sends a Password Authentication Protocol (PAP) request to a configured RADIUS server. The username and password are both equal to the MAC address being authenticated.

On the RADIUS server, PAP usernames and passwords must be configured in the MAC address format XX-XX-XX-XX-XX-XX (all in upper case).

Authenticated MAC addresses are stored as dynamic entries in the switch secure MAC address table and are removed when the aging time expires. The maximum number of secure MAC addresses supported for the switch system is 1024.

Configured static MAC addresses are added to the secure address table when seen on a switch port. Static addresses are treated as authenticated without sending a request to a RADIUS server.

MAC authentication, 802.1X, and port security cannot be configured together on the same port. Only one security mechanism can be applied.

MAC authentication cannot be configured on trunk ports.

When port status changes to down, all MAC addresses are cleared from the secure MAC address table. Static VLAN

assignments are not restored.

The RADIUS server may optionally return a VLAN identifier list. VLAN identifier list is carried in the "Tunnel-Private-Group-ID" attribute. The VLAN list can contain multiple VLAN identifiers in the format "1u,2t," where "u" indicates untagged VLAN and "t" tagged VLAN. The "Tunnel-Type" attribute should be set to "VLAN," and the "Tunnel-Medium-Type" attribute set to "802."

Example

```
Console(config-if)#network-access mode mac-authentication
Console(config-if)#
```

network-access max-mac-count

Use this command to set the maximum number of MAC addresses that can be authenticated on a port via all forms of authentication. Use the no form of this command to restore the default.

Syntax

network-access max-mac-count count

no network-access max-mac-count\

count - The maximum number of authenticated MAC addresses allowed. (Range: 1 to 2048; 0 for unlimited)

Default Setting

2048

Command Mode

Interface Configuration

Command Usage

The maximum number of MAC addresses per port is 2048, and the maximum number of secure MAC addresses supported for the switch system is 1024. When the limit is reached, all new MAC addresses are treated as an authentication failed.

Example

```
Console(config-if)#network-access max-mac-count 5
Console(config-if)#
```

mac-authentication intrusion-action

Use this command to configure the port response to a host MAC authentication failure. Use the no form of this command to restore the default.

Syntax

mac-authentication intrusion-action [block traffic | pass traffic] no mac-authentication intrusion-action Default Setting

Block Traffic

Command Mode

Interface Configuration

Example

```
Console(config-if)#mac-authentication intrusion-action block-traffic
Console(config-if)#
```

mac-authentication max-mac-count

Use this command to set the maximum number of MAC addresses that can be authenticated on a port via 802.1X authentication or MAC authentication. Use the no form of this command to restore the default.

Syntax

mac-authentication max-mac-count count no mac-authentication max-mac-count

count - The maximum number of 802.1X and MAC-authenticated MAC addresses allowed. (Range: 1-1024)

Default Setting

1024

Command Mode

Interface Configuration

Example

```
Console(config-if)#mac-authentication max-mac-count 32
Console(config-if)#
```

network-access dynamic-vlan

Use this command to enable dynamic VLAN assignment for an authenticated port. Use the no form to disable dynamic VLAN assignment.

Syntax

[no] network-access dynamic-vlan

Default Setting

Enabled

Command Mode

Interface Configuration

Command Usage

When enabled, the VLAN identifiers returned by the RADIUS server will be applied to the port, providing the VLANs have already been created on the switch. GVRP is not used to create the VLANs.

The VLAN settings specified by the first authenticated MAC address are implemented for a port. Other authenticated MAC addresses on the port must have same VLAN configuration, or they are treated as an authentication failure.

If dynamic VLAN assignment is enabled on a port and the RADIUS server returns no VLAN configuration, the authentication is still treated as a success, and the host assigned to the default untagged VLAN.

When the dynamic VLAN assignment status is changed on a port, all authenticated addresses are cleared from the secure MAC address table.

Example

The following **Example** enables dynamic VLAN assignment on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access dynamic-vlan
Console(config-if)#
```

network-access guest-vlan

Use this command to assign all traffic on a port to a guest VLAN when network access (MAC authentication) or 802.1X authentication is rejected. Use the no form of this command to disable guest VLAN assignment.

Syntax

network-access guest-vlan vlan-id

no network-access guest-vlan

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

The VLAN to be used as the guest VLAN must be defined and set as active (see "vlan database" on page 4-225).

When used with 802.1X authentication, the intrusion-action must be set for "guest-vlan" to be effective (see "dot1x intrusion-action").

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access guest-vlan 25
Console(config-if)#
```

mac-authentication reauth-time

Use this command to set the time period after which a connected MAC address must be re-authenticated. Use the no form of this command to restore the default value.

Syntax

mac-authentication reauth-time seconds

no mac-authentication reauth-time

seconds -The reauthentication time period.

(Range: 120-1000000 seconds)

Default Setting

1800

Command Mode

Global Configuration

Command Usage

The reauthentication time is a global setting and applies to all ports.

When the reauthentication time expires for a secure MAC address it is reauthenticated with the RADIUS server. During the reauthentication process traffic through the port remains unaffected.

Example

```
Console(config)#mac-authentication reauth-time 300
Console(config)#
```

clear network-access

Use this command to clear entries from the secure MAC addresses table.

Syntax

clear network-access mac-address-table [static | dynamic]

[address mac-address] [interface interface]

static - Specifies static address entries.

dynamic - Specifies dynamic address entries.

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-28)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#clear network-access mac-address-table interface ethernet 1/1
Console#
```

show network-access

Use this command to display the MAC authentication settings for port interfaces.

Syntax

show network-access [interface interface]

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-26)

Default Setting

Displays the settings for all interfaces.

Command Mode

Privileged Exec

Client Security Commands

Example

```
Console#show network-access interface ethernet 1/1
Global secure port information
Reauthentication Time: 1800

Port : 1/1
MAC Authentication: Disabled
MAC Authentication Intrusion action: Block traffic
MAC Authentication Maximum MAC Counts : 1024
Maximum MAC Counts : 2048
Dynamic VLAN Assignment: Enabled
```

```
Guest VLAN : Disabled
Console#
```

show network-access mac-address-table

Use this command to display secure MAC address table entries.

Syntax

show network-access mac-address-table [static | dynamic] [address mac-address [mask]] [interface interface] [sort {address | interface}] static - Specifies static address entries.

dynamic - Specifies dynamic address entries.

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

mask -Specifies a MAC address bit mask for filtering displayed addresses.

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-28)

sort - Sorts displayed entries by either MAC address or interface.

Default Setting

Displays all filters.

Command Mode

Privileged Exec

Command Usage

When using a bit mask to filter displayed MAC addresses, a 1 means "care" and a 0 means "don't care". For **Example**, a MAC of 00-00-01-02-03-04 and mask FF-FF-FF-00-00-00 would result in all MACs in the range 00-00-01-00-00-00 to 00-00-01-FF-FF-FF to be displayed. All other MACs would be filtered out.

Example

```
Console#show network-access mac-address-table

Port MAC-Address          RADIUS-Server Attribute Time

1/1 00-00-01-02-03-04 172.155.120.17   Static    00d06h32m50s
1/1 00-00-01-02-03-05 172.155.120.17   Dynamic   00d06h33m20s
1/1 00-00-01-02-03-06 172.155.120.17   Static    00d06h35m10s
1/3 00-00-01-02-03-07 172.155.120.17   Dynamic   00d06h34m20s
```

```
Console#
```

5.13.3 Web Authentication

Web authentication allows stations to authenticate and access the network in situations where 802.1X or Network Access authentication methods are infeasible or impractical. The web authentication feature allows unauthenticated hosts to request and receive a DHCP assigned IP address and perform DNS queries. All other traffic, except for HTTP protocol traffic, is blocked. The switch intercepts http protocol traffic and redirects it to a switch-generated web page that facilitates username and password authentication via RADIUS. Once authentication is successful, the web browser is forwarded on to the originally requested web page. .

1. RADIUS authentication must be activated and configured properly for the web authentication feature to work properly. (See "RADIUS Client" on page 4-88.)
2. Web authentication cannot be configured on trunk ports.

Command	Function	Mode
web-auth login-attempts	Defines the limit for failed web authentication login attempts	GC
web-auth quiet-period	Defines the amount of time to wait after the limit for failed login attempts is exceeded.	GC
web-auth session-timeout	Defines the amount of time a session remains valid	GC
web-auth system-auth-control	Enables web authentication globally for the switch	GC
web-auth	Enables web authentication for an interface	IC
web-auth re-authenticate (Port)	Ends all web authentication sessions on the port andforces the users to re-authenticate	PE
web-auth re-authenticate (IP)	Ends the web authentication session associated with the designated IP address and forces the user to re-authenticate	PE
show web-auth	Displays global web authentication parameters	PE
show web-auth interface	Displays interface-specific web authenticationparameters and statistics	PE
show web-auth summary	Displays a summary of web authentication port parameters and statistics	PE

Table 5-43 Web Authentication

web-auth login-attempts

This command defines the limit for failed web authentication login attempts. After the limit is reached, the switch refuses further login attempts until the quiet time expires. Use the no form to restore the default.

Syntax

web-auth login-attempts count

no web-auth login-attempts

count -The limit of allowed failed login attempts. (Range: 1-3)

Default Setting

3 login attempts

Command Mode

Global Configuration

Example

```
Console(config)#web-auth login-attempts 2
Console(config)#
```

web-auth quiet-period

This command defines the amount of time a host must wait after exceeding the limit for failed login attempts, before it may attempt web authentication again. Use the no form to restore the default.

Syntax

web-auth quiet-period time no web-auth quiet period

time -The amount of time the host must wait before attempting authentication again. (Range: 1-180 seconds)

Default Setting

60 seconds

Command Mode

Global Configuration

Example

```
Console(config)#web-auth quiet-period 120
Console(config)#
```

web-auth session-timeout

This command defines the amount of time a web-authentication session remains valid. When the session-timeout has been reached, the host is logged off and must be re-authenticated the next time data is transmitted. Use the no form to restore the default.

Syntax

web-auth session-timeout timeout no web-auth session timeout

timeout -The amount of time that an authenticated session remains valid. (Range: 300-3600 seconds)

Default Setting

3600 seconds

Command Mode

Global Configuration

Example

```
Console(config)#web-auth session-timeout 1800
Console(config)#
```

web-auth system-auth-control

This command globally enables web authentication for the switch. Use the no form to restore the default.

Syntax

[no] web-auth system-auth-control

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Both web-auth system-auth-control for the switch and web-auth for an interface must be enabled for web authentication to be active.

Example

```
Console(config)#web-auth system-auth-control
Console(config)#
```

web-auth

This command enables web authentication for a port. Use the no form to restore the default.

Syntax

[no] web-auth

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

Both web-auth system-auth-control for the switch and web-auth for a port must be enabled for web authentication to be active.

Example

```
Console(config-if)#web-auth
Console(config-if)#
```

web-auth re-authenticate (Port)

This command ends all web authentication sessions connected to the port and forces the users to re-authenticate.

Syntax

web-auth re-authenticate interface interface

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-28)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#web-auth re-authenticate interface ethernet 1/2
Console#
```

web-auth re-authenticate (IP)

This command ends the web authentication session associated with the designated IP address and forces the user to re-authenticate.

Syntax

web-auth re-authenticate interface interface ip

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-28)

ip - IPv4 formatted IP address.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#web-auth re-authenticate interface ethernet 1/2 192.168.1.5
Console#
```

show web-auth

This command displays global web authentication parameters.

Syntax

show web-auth

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show web-auth
Global Web-Auth Parameters
System Auth Control    : Enabled
Session Timeout : 3600
Quiet Period : 60
Max Login Attempts : 3
Console#
```

show web-auth interface

This command displays interface-specific web authentication parameters and statistics.

Syntax

show web-auth interface interface

interface - Specifies a port interface.

ethernet unit/port

-unit - This is unit 1.

-port - Port number. (Range: 1-20)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

The session timeout displayed by this command is expressed in seconds.

Example

```
Console#show web-auth interface ethernet 1/2
Web Auth Status : Enabled
Host Summary
IP address    Web-Auth-State Remaining-Session-Time
1.1.1.1    Authenticated    295
1.1.1.2    Authenticated    111
Console#
```

show web-auth summary

This command displays a summary of web authentication port parameters and statistics.

Syntax

show web-auth summary

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show web-auth summary

Global Web-Auth Parameters

   System Auth Control   : Enabled
Port Status       Authenticated Host Count

1/ 1 Disabled 0
1/ 2 Enabled 8
1/ 3 Disabled 0
1/ 4 Disabled 0
1/ 5 Disabled 0

.
```

5.13.4 DHCP Snooping Commands

DHCP snooping allows a switch to protect a network from rogue DHCP servers or other devices which send port-related information to a DHCP server. This information can be useful in tracking an IP address back to a physical port. This section describes commands used to configure DHCP snooping.

Command	Function	Mode
ip dhcp snooping	Enables DHCP snooping globally	GC
ip dhcp snooping vlan	Enables DHCP snooping on the specified VLAN	GC
ip dhcp snooping trust	Configures the specified interface as trusted	IC
ip dhcp snooping verifymac-address	Verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header	GC
ip dhcp snoopinginformation option	Enables or disables DHCP Option 82 information relay	GC
ip dhcp snoopinginformation policy	Sets the information option policy for DHCP client packets thatinclude Option 82 information	GC
show ip dhcp snooping	Shows the DHCP snooping configuration settings	PE
show ip dhcp snoopingbinding	Shows the DHCP snooping binding table entries	PE

Table 5-44 DHCP Snooping Commands

ip dhcp snooping

This command enables DHCP snooping globally. Use the no form to restore the default setting.

Syntax

[no] ip dhcp snooping

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Network traffic may be disrupted when malicious DHCP messages are received from an outside source. DHCP snooping is used to filter DHCP messages received on an unsecure interface from outside the network or firewall. When DHCP snooping is enabled globally by this command, and enabled on a VLAN interface by the ip dhcp snooping vlan command (page 4-148), DHCP messages received on an untrusted interface (as specified by the no ip dhcp snooping trust command, page 4-149) from a device not listed in the DHCP snooping table will be dropped.

When enabled, DHCP messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCP snooping.

Table entries are only learned for untrusted interfaces. Each entry includes a MAC address, IP address, lease time, VLAN

identifier, and port identifier.

When DHCP snooping is enabled, the rate limit for the number of DHCP messages that can be processed by the switch is 100 packets per second. Any DHCP packets in excess of this limit are dropped.

Filtering rules are implemented as follows: -If the global DHCP snooping is disabled, all DHCP packets are forwarded. -If DHCP snooping is enabled globally, and also enabled on the VLAN where

the DHCP packet is received, all DHCP packets are forwarded for a trusted port. If the received packet is a DHCP ACK message, a dynamic DHCP snooping entry is also added to the binding table.

- If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is not trusted, it is processed as follows:

* If the DHCP packet is a reply packet from a DHCP server (including OFFER, ACK or NAK messages), the packet is dropped.

* If the DHCP packet is from a client, such as a DECLINE or RELEASE message, the switch forwards the packet only if the corresponding entry is found in the binding table.

* If the DHCP packet is from client, such as a DISCOVER, REQUEST, INFORM, DECLINE or RELEASE message, the packet is forwarded if MAC address verification is disabled (as specified by the ip dhcp snooping verify mac-address command, page 4-150). However, if MAC address verification is enabled, then the packet will only be forwarded if the client's hardware address stored in the DHCP packet is the same as the source MAC address in the Ethernet header.

* If the DHCP packet is not a recognizable type, it is dropped. -If a DHCP packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.

- If a DHCP packet is from server is received on a trusted port, it will be forwarded to both trusted and untrusted ports in the same VLAN.

If the DHCP snooping is globally disabled, all dynamic bindings are removed from the binding table.

Additional considerations when the switch itself is a DHCP client – The port(s) through which the switch submits a client request to the DHCP server must be configured as trusted (ip dhcp snooping trust, page 4-149). Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCP server. Also, when the switch sends out DHCP client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCP server, any packets received from untrusted ports are dropped.

Example

This Example enables DHCP snooping globally for the switch.

```
Console(config)#ip dhcp snooping
Console(config)#
```

Related Commands

ip dhcp snooping vlan

ip dhcp snooping trust

ip dhcp snooping vlan

This command enables DHCP snooping on the specified VLAN. Use the no form to restore the default setting.

Syntax

[no] ip dhcp snooping vlan vlan-id

vlan-id -ID of a configured VLAN (Range: 1-4094)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

When DHCP snooping enabled globally using the ip dhcp snooping command (page 4-146), and enabled on a VLAN with this command, DHCP packet filtering will be performed on any untrusted ports within the VLAN as specified by the ip dhcp snooping trust command (page 4-149).

When the DHCP snooping is globally disabled, DHCP snooping can still be configured for specific VLANs, but the changes will not take effect until DHCP snooping is globally re-enabled.

When DHCP snooping is globally enabled, configuration changes for specific VLANs have the following effects: -If DHCP snooping is disabled on a VLAN, all dynamic bindings learned for

this VLAN are removed from the binding table.

Example

This Example enables DHCP snooping for VLAN 1.

```
Console(config)#ip dhcp snooping vlan 1
Console(config)#
```

Related Commands

ip dhcp snooping

ip dhcp snooping trust

ip dhcp snooping trust

This command configures the specified interface as trusted. Use the no form to restore the default setting.

Syntax

[no] ip dhcp snooping trust

Default Setting

All interfaces are untrusted

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or firewall.

Set all ports connected to DHCP servers within the local network or firewall to trusted, and all other ports outside the local network or firewall to untrusted.

When DHCP snooping ia enabled globally using the ip dhcp snooping command (page 4-146), and enabled on a VLAN with ip dhcp snooping vlan command (page 4-148), DHCP packet filtering will be performed on any untrusted ports within the VLAN according to the default status, or as specifically configured for an interface with the no ip dhcp snooping trust command.

When an untrusted port is changed to a trusted port, all the dynamic DHCP snooping bindings associated with this port are removed.

Additional considerations when the switch itself is a DHCP client – The port(s) through which it submits a client request to the DHCP server must be configured as trusted.

Example

This Example sets port 5 to untrusted.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no ip dhcp snooping trust
Console(config-if)#
```

Related Commands

ip dhcp snooping

ip dhcp snooping vlan

ip dhcp snooping verify mac-address

This command verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header. Use the no form to disable this function.

Syntax

[no] ip dhcp snooping verify mac-address

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

If MAC address verification is enabled, and the source MAC address in the Ethernet header of the packet is not same as the client's hardware address in the DHCP packet, the packet is dropped.

Example

This Example enables MAC address verification.

```
Console(config)#ip dhcp snooping verify mac-address
Console(config)#
```

Related Commands

ip dhcp snooping

ip dhcp snooping vlan

ip dhcp snooping trust

ip dhcp snooping information option

This command enables the DHCP Option 82 information relay for the switch. Use the no form to disable this function.

Syntax

[no] ip dhcp snooping information option

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to the DHCP server. Known as DHCP Option 82, it allows compatible DHCP servers to use the information when assigning IP addresses, or to set other services or policies for clients.

When the DHCP Snooping Information Option is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server by the switch port to which they are connected rather than just their MAC address. DHCP client-server exchange messages are then forwarded directly between the server and client without having to flood them to the entire VLAN.

DHCP snooping must be enabled on the switch for the DHCP Option 82 information to be inserted into packets.

DHCP request packets are flooded onto all attached VLANs other than the inbound VLAN under the following situations: -DHCP snooping is disabled. -The request packet contains a valid relay agent address field.

• DHCP reply packets are flooded onto all attached VLANs other than the inbound management VLAN under the following situations: -The reply packet does not contain Option 82 information. -The reply packet contains a valid relay agent address field (that is not the

address of this switch) or a zero relay address.

Use the ip dhcp snooping information option command (page 4-150) to specify how to handle DHCP client request packets which already contain Option 82 information.

Example

This Example enables the DHCP Snooping Information Option.

```
Console(config)#ip dhcp snooping information option
Console(config)#
```

ip dhcp snooping information policy

This command sets the DHCP snooping information option policy for DHCP client packets that include Option 82 information.

Syntax

ip dhcp snooping information policy {drop | keep | replace}

drop - Drop the request packet instead of relaying it.

keep - Retain the Option 82 information in the client request, and unicast the packet to the DHCP server.

replace -Replace the Option 82 information in the client's request with information about the relay agent itself, insert the relay agent's address (when DHCP snooping is enabled), and unicast the packet to the DHCP server.

Default Setting

replace

Command Mode

Global Configuration

Command Usage

When the switch receives DHCP packets from clients that already include DHCP Option 82 information, the switch can be configured to set the action policy for these packets. Either the switch can drop the DHCP packets, keep the existing information, or replace it with the switch's relay information.

Example

```
Console(config)#ip dhcp snooping information policy drop
Console(config)#
```

Related Commands

ip dhcp snooping information option

ip dhcp snooping

show ip dhcp snooping

This command shows the DHCP snooping configuration settings.

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp snooping
Global DHCP Snooping status: disable
DHCP Snooping Information Option Status: disable
DHCP Snooping Information Policy: replace
DHCP Snooping is configured on the following VLANs:
1
Verify Source Mac-Address: enable
Interface    Trusted

Eth 1/1    No
Eth 1/2    No
Eth 1/3    No
Eth 1/4    No
Eth 1/5    Yes
```

show ip dhcp snooping binding

This command shows the DHCP snooping binding table entries.

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp snooping binding
MacAddress    IpAddress Lease(sec) Type    VLAN Interface


11-22-33-44-55-66 192.168.0.99                0 Static 1 Eth 1/5
Console#
```

5.13.5 IP Source Guard Commands

IP Source Guard is a security feature that filters IP traffic on network interfaces based on manually configured entries in the IP Source Guard table, or static and dynamic entries in the DHCP Snooping table when enabled (see "**DHCP Snooping Commands**"). IP source guard can be used to prevent traffic attacks caused when a host tries to use the IP address of a neighbor to access the network. This section describes commands used to configure IP Source Guard.

Command	Function	Mode
ip source-guard	Configures the switch to filter inbound traffic based on source IPaddress, or source IP address and corresponding MAC address	IC
ip source-guard binding	Adds a static address to the source-guard binding table	GC
show ip source-guard	Shows whether source guard is enabled or disabled on eachinterface	PE
show ip source-guardbinding	Shows the source guard binding table	PE

Table 5-45 IP Source Guard Commands

ip source-guard

This command configures the switch to filter inbound traffic based source IP address, or source IP address and corresponding MAC address. Use the no form to disable this function.

Syntax

ip source-guard {sip | sip-mac}

no ip source-guard

sip -Filters traffic based on IP addresses stored in the binding table.

sip-mac -Filters traffic based on IP addresses and corresponding MAC addresses stored in the binding table.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Source guard is used to filter traffic on an unsecure port which receives messages from outside the network or firewall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.
- Setting source guard mode to "sip" or "sip-mac" enables this function on the selected port. Use the "sip" option to check the VLAN ID, source IP address, and port number against all entries in the binding table. Use the "sip-mac" option to check these same parameters, plus the source MAC address. Use the no source guard command to disable this function on the selected port.
- When enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table.
- Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding, Static-DHCP-Binding), VLAN identifier, and port identifier.
- Static addresses entered in the source guard binding table with the ip source-guard binding command are automatically configured with an infinite lease time. Dynamic entries learned via DHCP snooping are configured by the DHCP server itself; static entries include a manually configured lease time.

- If the IP source guard is enabled, an inbound packet's IP address (sip option) or both its IP address and corresponding MAC address (sip-mac option) will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- Filtering rules are implemented as follows:
  - If DHCP snooping is disabled, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, the packet will be forwarded.
  - If the DHCP snooping is enabled, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding or dynamic DHCP snooping binding, the packet will be forwarded.
  - If IP source guard if enabled on an interface for which IP source bindings (dynamically learned via DHCP snooping or manually configured) are not yet configured, the switch will drop all IP traffic on that port, except for DHCP packets.

Example

This Example enables IP source guard on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard sip
Console(config-if)#
```

Related Commands

ip source-guard binding

ip dhcp snooping

ip dhcp snooping vlan

ip source-guard binding

This command adds a static address to the source-guard binding table. Use the no form to remove a static entry.

Syntax

ip source-guard binding mac-address vlan vlan-id ip-address interface ethernet unit/port no ip source-guard binding

mac-address vlan vlan-id

mac-address - A valid unicast MAC address.

vlan-id -ID of a configured VLAN (Range: 1-4094)

ip-address -A valid unicast IP address, including classful types A, B or C.

unit - Stack unit. (Range: 1)

port - Port number. (Range: 1-28)

Default Setting

No configured entries

Command Mode

Global Configuration

Command Usage

- Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding), VLAN identifier, and port identifier.
- All static entries are configured with an infinite lease time, which is indicated with a value of zero by the **show ip source-guard** command.
- When source guard is enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping or static addresses configured in the source guard binding table with this command.
- Static bindings are processed as follows: -If there is no entry with same VLAN ID and MAC address, a new entry is added to binding table using the type of static IP source guard binding.
  - If there is an entry with same VLAN ID and MAC address, and the type of entry is static IP source guard binding, then the new entry will replace the old one.
  - If there is an entry with same VLAN ID and MAC address, and the type of the entry is dynamic DHCP snooping binding, then the new entry will replace the old one and the entry type will be changed to static IP source guard binding.

Example

This Example configures a static source-guard binding on port 5.

```
Console(config)#ip source-guard binding 11-22-33-44-55-66 vlan 1
192.168.0.99 interface ethernet 1/5
Console(config-if)#
```

Related Commands

ip source-guard

ip dhcp snooping

ip dhcp snooping vlan

show ip source-guard

This command shows whether source guard is enabled or disabled on each interface.

Command Mode

Privileged Exec

Example

```
Console#show ip source-guard
Interface    Filter-type
```

```
Eth 1/1   DISABLED
Eth 1/2   DISABLED
Eth 1/3   DISABLED
Eth 1/4   DISABLED
Eth 1/5   SIP
Eth 1/6   DISABLED
```

show ip source-guard binding

This command shows the source guard binding table.

Syntax

show ip source-guard binding [dhcp-snooping | static]

dhcp-snooping - Shows dynamic entries configured with DHCP Snooping commands (see page 4-146)

static - Shows static entries configured with the ip source-guard binding command (see page 4-155).

Command Mode

Privileged Exec

Access Control List Commands

Example

```
Console# show ip source-guard binding
MacAddress          IpAddress         Lease(sec)    Type    VLAN    Interface
------------------  ----------------  ----------  --------  ------  ----------
11-22-33-44-55-66   192.168.0.99              0     Static     1      Eth 1/5

Console#
```

5.14 Access Control List Commands

Access Control Lists (ACL) provide packet filtering for IP frames (based on address, protocol, or Layer 4 protocol port number or TCP control code) or any frames (based on MAC address or Ethernet type). To filter packets, first create an access list, add the required rules and then bind the list to a specific port. This section describes the Access Control List commands.

Command Grup	Function
IP ACLs	Configures ACLs based on IP addresses, TCP/UDP port number, andprotocol type
MAC ACLs	Configures ACLs based on hardware addresses, packet format, and Ethernet type
ACL Information	Displays ACLs and associated rules; shows ACLs assigned to each port

Table 5-46 Access Control Lists

5.14.1 IP ACLs

The commands in this section configure ACLs based on IP addresses, TCP/UDP port number, protocol type, and TCP control code. To configure IP ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

Command	Function	Mode
access-list ip	Creates an IP ACL and enters configuration mode for standard or extended IP ACLs	GC
permit, deny	Filters packets matching a specified source IP address	STD-ACL
permit, deny	Filters packets meeting the specified criteria, including source and destination IP address, TCP/UDP port number, protocol type, and TCP control code	EXT-ACL
show ip access-list	Displays the rules for configured IP ACLs	PE
ip access-group	Adds a port to an IP ACL	IC
show ip access-group	Shows port assignments for IP ACLs	PE
map access-list ip	Sets the CoS value and corresponding output queue for packets matching an ACL rule	IC
show map access-list ip	Shows CoS value mapped to an access list for an interface	PE

Table 5-47 IP ACL Commands

access-list ip

This command adds an IP access list and enters configuration mode for standard or extended IP ACLs. Use the no form to remove the specified ACL.

Syntax

[no] **access-list ip** {**standard** | **extended**} acl_name

- **standard** – Specifies an ACL that filters packets based on the source IP address.
- **extended** – Specifies an ACL that filters packets based on the source or destination IP address, and other more specific criteria.
- **acl_name** – Name of the ACL. (Maximum length: 16 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- When you create a new ACL or enter configuration mode for an existing ACL, use the permit or deny command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.
- To remove a rule, use the no permit or no deny command followed by the exact text of a previously configured rule.
- An ACL can contain up to 100 rules.

Example

```
Console(config)#access-list ip standard david
Console(config-std-acl)#
```

Related Commands

permit, deny 4-159 ip access-group

show ip access-list

permit, deny (Standard ACL)

This command adds a rule to a Standard IP ACL. The rule sets a filter condition for packets emanating from the specified source. Use the **no** form to remove a rule.

Syntax

[no]{permit | deny}{any | source bitmask | host source}

any – Any source IP address.

source – Source IP address.

bitmask – Decimal number representing the address bits to match.

host – Keyword followed by a specific IP address.

Default Setting

None

Command Mode

Standard ACL

Command Usage

New rules are appended to the end of the list.

Address bitmasks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate "match" and 0 bits to indicate "ignore." The bitmask is bitwise ANDed with the specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

Example

This example configures one permit rule for the specific address 10.1.1.21 and another rule for the address range 168.92.16.x – 168.92.31.x using a bitmask.

```
Console(config-std-acl)#permit host 10.1.1.21
Console(config-std-acl)#permit 168.92.16.0 255.255.240.0
```

Related Commands

access-list ip

permit, deny (Extended ACL)

This command adds a rule to an Extended IP ACL. The rule sets a filter condition for packets with specific source or destination IP addresses, protocol types, source or destination protocol ports, or TCP control codes. Use the no form to remove a rule.

Syntax

[no] {permit | deny}[protocol-number | udp]
{any | source address-bitmask | host source}
{any | destination address-bitmask | host destination}
[precedence precedence] [dscp dscp]
[source-port sport [end]] [destination-port dport [end]]

[no] {permit | deny} tcp
{any | source address-bitmask | host source}
{any | destination address-bitmask | host destination}
[precedence precedence] [dscp dscp]
[source-port sport [end]] [destination-port dport [end]]
[control-flag control-flag]

- protocol-number – A specific protocol number. (Range: 0-255)
- source – Source IP address.
- destination – Destination IP address.
- address-bitmask – Decimal number representing the address bits to match.
- host – Keyword followed by a specific IP address.
- precedence – IP precedence level. (Range: 0-7)
- dscp – DSCP priority level. (Range: 0-63)
- sport – Protocol21 source port number. (Range: 0-65535)
- dport – Protocol21 destination port number. (Range: 0-65535)
- end – Upper bound of the protocol port range. (Range: 0-65535)
- control-flag – Decimal number (representing a bit string) that specifies flag bits in byte 14 of the TCP header. (Range: 0-63)

Default Setting

None

Command Mode

Extended ACL

Command Usage

All new rules are appended to the end of the list.

Address bitmasks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate "match" and 0 bits to indicate "ignore." The bitmask is bitwise ANDed with the 21.

Includes TCP, UDP or other protocol types.

specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

• The following control codes may be specified:

-1 (fin) – Finish

-2 (syn) – Synchronize

-4 (rst) – Reset

-8 (psh) – Push

-16 (ack) – Acknowledgement

-32 (urg) – Urgent pointer

To define more than one control code, set the equivalent binary bit to "1" to indicate the required codes. For Example, to set both SYN and ACK valid, use "control-code 18"

Example

This Example accepts any incoming packets if the source address is within subnet 10.7.1.x. For Example, if the rule is matched; i.e., the rule (10.7.1.0 & 255.255.255.0) equals the masked address (10.7.1.2 & 255.255.255.0), the packet passes through.

```
Console(config-ext-acl)# permit 10.7.1.1 255.255.255.0 any
Console(config-ext-acl)#
```

This allows TCP packets from class C addresses 192.168.1.0 to any destination address when set for destination TCP port 80 (i.e., HTTP).

```
Console(config-ext-acl)# permit 192.168.1.0 255.255.255.0 any
   destination-port 80

Console(config-ext-acl)#
```

This permits all TCP packets from class C addresses 192.168.1.0 with the TCP control code set to "SYN."

```
Console(config-ext-acl)#permit tcp 192.168.1.0 255.255.255.0 any
  control-flag 2

Console(config-ext-acl)#
```

Related Commands

access-list ip

show ip access-list

This command displays the rules for configured IP ACLs.

Syntax

show ip access-list {standard | extended} [acl_name]

standard – Specifies a standard IP ACL.

extended – Specifies an extended IP ACL.

acl_name – Name of the ACL. (Maximum length: 16 characters)

Command Mode

Privileged Exec

Example

```
Console#show ip access-list standard

IP standard access-list david:
  permit host 10.1.1.21
  permit 168.92.0.0 255.255.255.0

Console#
```

Related Commands

permit, deny

ip access-group

ip access-group

This command binds a port to an IP ACL. Use the no form to remove the port.

Syntax

[no] ip access-group acl_name {in | out}

acl_name – Name of the ACL. (Maximum length: 16 characters)

in – Indicates that this list applies to ingress packets.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

A port can only be bound to one ACL.

If a port is already bound to an ACL and you bind it to a different ACL, the switch will replace the old binding with the new one.

You must configure a mask for an ACL rule before you can bind it to a port.

Example

```
Console(config)#int eth 1/25
Console(config-if)#ip access-group david in
Console(config-if)#
```

Related Commands

show ip access-list

show ip access-group

This command shows the ports assigned to IP ACLs.

Command Mode

Privileged Exec

Example

```
Console#show ip access-group
Interface ethernet 1/25


 IP access-list david in
```

```
Console#
```

Related Commands

ip access-group

map access-list ip

This command sets the output queue for packets matching an ACL rule. The specified CoS value is only used to map the matching packet to an output queue; it is not written to the packet itself. Use the no form to remove the CoS mapping.

Syntax

[no] map access-list ip acl_name cos cos-value

acl_name – Name of the ACL. (Maximum length: 16 characters)

cos-value – CoS value. (Range: 0-7)

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

You must configure an ACL before you can map CoS values to the rule.

A packet matching a rule within the specified ACL is mapped to one of the output queues as shown in the following table.

For information on mapping the CoS values to output queues, see **queue cos-map**.

Priority	1,2	0,3	4,5	6,7
Queue	0	1	2	3

Table 5-48 Egress Queue Priority Mapping

Example

```
Console(config)# interface ethernet 1/2
Console(config-if)#map access-list ip bill cos 0
Console(config-if)
```

Related Commands

queue cos-map

show map access-list ip

show map access-list ip

This command shows the CoS value mapped to an IP ACL for the current interface. (The CoS value determines the output queue for packets matching an ACL rule.)

Syntax

show map access-list ip [interface] interface

• ethernet unit/port

-unit - This is device 1.

-port - Port number.

Command Mode

Privileged Exec

Example

```
Console# show map access-list ip
  Access-list to COS of Eth 1/4
  Access-list ALS1 cos 0
Console#
```

Related Commands

map access-list ip

5.14.2 MAC ACLs

The commands in this section configure ACLs based on hardware addresses, packet format, and Ethernet type. To configure MAC ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports

Command	Function	Mode
access-list mac	Creates a MAC ACL and enters configuration mode	GC
permit, deny	Filters packets matching a specified source and destination address, packet format, and Ethernet type	MAC-ACL
show mac access-list	Displays the rules for configured MAC ACLs	PE
mac access-group	Adds a port to a MAC ACL	IC
show mac access-group	Shows port assignments for MAC ACLs	PE
map access-list mac	Sets the CoS value and corresponding output queue for packets matching an ACL rule	IC

show map access-list mac	Shows CoS value mapped to an access list for an interface	PE

Table 5-49 MAC ACL Commands

access-list mac

This command adds a MAC access list and enters MAC ACL configuration mode. Use the no form to remove the specified ACL.

Syntax

[no] access-list mac acl_name acl_name – Name of the ACL. (Maximum length: 16 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

When you create a new ACL or enter configuration mode for an existing ACL, use the permit or deny command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.

To remove a rule, use the no permit or no deny command followed by the exact text of a previously configured rule.

An ACL can contain up to 100 rules.

Example

```
Console(config)#access-list mac jerry
Console(config-mac-acl)#
```

Related Commands

permit, deny

mac access-group

show mac access-list

permit, deny (MAC ACL)

This command adds a rule to a MAC ACL. The rule filters packets matching a specified MAC source or destination address (i.e., physical layer address), or Ethernet protocol type. Use the no form to remove a rule.

Syntax

[no]{permit | deny} {any | host source | source address-bitmask} {any | host destination | destination address-bitmask} [cos cos-value] [vid vid vid-bitmask] [ethertype protocol]

The default is for Ethernet II packets.

[no]{permit | deny} eth2

{any | host source | source address-bitmask}

{any | host destination | destination address-bitmask}

[cos cos-value] [vid vid vid-bitmask] [ethertype protocol]

[no]{permit | deny} 802.3

{any | host source | source address-bitmask}

{any | host destination | destination address-bitmask}

[cos cos-value] [vid vid vid-bitmask]

tagged-eth2 – Tagged Ethernet II packets.

untagged-eth2 – Untagged Ethernet II packets.

tagged-802.3 – Tagged Ethernet 802.3 packets.

untagged-802.3 – Untagged Ethernet 802.3 packets.

any – Any MAC source or destination address.

host – A specific MAC address.

source – Source MAC address.

destination – Destination MAC address range with bitmask.

address-bitmask22 – Bitmask for MAC address (in hexidecimal format).

cos-value - Class-of-Service value (Range: 0-7)

vid – VLAN ID. (Range: 1-4094)

vid-bitmask22 – VLAN bitmask. (Range: 1-4095)

protocol – A specific Ethernet protocol number. (Range: 0-ffff hex.)

protocol-bitmask22 – Protocol bitmask. (Range: 600-fff hex.)

Default Setting

None

Command Mode

MAC ACL

22. For all bitmasks, "1" means care and "0" means ignore.

Command Usage

New rules are added to the end of the list.

The ethertype option can only be used to filter Ethernet II formatted packets.

A detailed listing of Ethernet protocol types can be found in RFC 1060. A few of the more common types include the following: -0800 -IP -0806 -ARP -8137 -IPX To define more than one protocol, set the equivalent binary bit to "1" to indicate the required protocols.

Example

This rule permits packets from any source MAC address to the destination address 00-e0-29-94-34-de where the

Ethernet type is 0800.

```
Console(config-mac-acl)#permit any host 00-e0-29-94-34-de ethertype 0800
Console(config-mac-acl)#
```

Related Commands

access-list mac

show mac access-list

This command displays the rules for configured MAC ACLs.

Syntax

show mac access-list [acl_name] acl_name – Name of the ACL. (Maximum length: 16 characters)

Command Mode

Privileged Exec

Example

```
Console#show mac access-list
MAC access-list jerry:
permit any 00-e0-29-94-34-de ethertype 0800
Console#
```

Related Commands

permit, deny

mac access-group

mac access-group

This command binds a port to a MAC ACL. Use the no form to remove the port.

Syntax

mac access-group acl_name {in | out} acl_name – Name of the ACL. (Maximum length: 16 characters)

in – Indicates that this list applies to ingress packets.

• out – Indicates that this list applies to egress packets.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

A port can only be bound to one ACL.

If a port is already bound to an ACL and you bind it to a different ACL, the switch will replace the old binding with the new one.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#mac access-group jerry in
Console(config-if)#
```

Related Commands

show mac access-list

show mac access-group

This command shows the ports assigned to MAC ACLs.

Command Mode

Privileged Exec

Example

```
Console#show mac access-group
Interface ethernet 1/5

MAC access-list M5 in
Console#
```

Related Commands

mac access-group

map access-list mac

This command sets the output queue for packets matching an ACL rule. The specified CoS value is only used to map the matching packet to an output queue; it is not written to the packet itself. Use the no form to remove the CoS mapping.

Syntax

[no] map access-list mac acl_name cos cos-queue acl_name – Name of the MAC ACL. (Maximum length: 16 characters)

cos-queue – Port CoS queue. (Range: 0-3)

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

You must configure an ACL before you can map a CoS queue to the rule.

A packet matching a rule within the specified ACL is mapped to one of the output queues as shown below.

Priority	1,2	0,3	4,5	6,7
Queue	0	1	2	3

Table 4-50 Egress Queue Priority Mapping

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#map access-list mac steve cos 0
Console(config-if)#
```

Related Commands

queue cos-map

show map access-list mac

show map access-list mac

This command shows the CoS value mapped to a MAC ACL for the current interface. (The CoS value determines the output queue for packets matching an ACL rule.)

Syntax

show map access-list mac [interface] interface

• ethernet unit/port

-unit - This is unit 1.

-port - Port number.

Command Mode

Privileged Exec

Example

```
Console# show map access-list mac
   Access-list to COS of Eth 1/5
   Access-list jerry cos 0
Console#
```

Related Commands

map access-list mac

5.14.3 ACL Information

Command	Function	Mode
show access-list	Show all ACLs and associated rules	PE
show access-group	Shows the ACLs assigned to each port	PE

Table 5-51 ACL Information

show access-list

This command shows all ACLs and associated rules.

Command Mode

Privileged Exec

Example

```
Console#show access-list

IP standard access-list david:
   permit host 10.1.1.21
   permit 168.92.16.0 255.255.240.0

IP extended access-list bob:
   permit 10.7.1.1 255.255.255.0 any
   permit 192.168.1.0 255.255.255.0 any destination-port 80 80
   permit 192.168.1.0 255.255.255.0 any protocol tcp control-code 2

IP access-list jerry:
   permit any host 00-30-29-94-34-de ethertype 800 800
```

```
IP extended access-list A6:
   deny tcp any any control-flag 2
   permit any any

Console#
```

show access-group

This command shows the port assignments of ACLs.

Command Mode

Privileged Executive

Example

```
Console# show access-group
Interface ethernet 1/1
  IP access-list jerry in

Interface ethernet 1/10
  IP access-list jerry out
Console#
```

5.15 Interface Commands

These commands are used to display or set communication parameters for an Ethernet port, aggregated link, or VLAN.

Command	Function	Mode
interface	Configures an interface type and enters interface configuration mode	GC
description	Adds a description to an interface configuration	IC
speed-duplex	Configures the speed and duplex operation of a given interface when autonegotiation is disabled	IC
negotiation	Enables autonegotiation of a given interface	IC
capabilities	Advertises the capabilities of a given interface for use in autonegotiation	IC
flowcontrol	Enables flow control on a given interface	IC
shutdown	Disables an interface	IC

broadcast byte-rate	Configures the broadcast storm control threshold	GC
switchport broadcast	Enables broadcast storm control on an interface	IC
clear counters	Clears statistics on an interface	PE
show interfaces status	Displays status for the specified interface	NE, PE
show interfaces counters	Displays statistics for the specified interfaces	NE, PE
show interfaces switchport	Displays the administrative and operational status of aninterface	NE, PE

Table 4-52 Interface Commands

interface

This command configures an interface type and enters interface configuration mode. Use the no form to remove a trunk.

Syntax

interface interface

no interface port-channel channel-id

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

• vlan vlan-id (Range: 1-4094)

Default Setting

None

Command Mode

Global Configuration

Example

To specify port 24, enter the following command:

```
Console(config)#interface ethernet 1/24
Console(config-if)#
```

description

This command adds a description to an interface. Use the no form to remove the description.

Syntax

description string

no description

string - Comment or a description to help you remember what is attached to this interface. (Range: 1-64 characters)

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

The following Example adds a description to port 24.

```
Console(config)#interface ethernet 1/24
Console(config-if)#description RD-SW#3
Console(config-if)#
```

speed-duplex

This command configures the speed and duplex mode of a given interface when autonegotiation is disabled. Use the no form to restore the default.

Syntax

speed-duplex {1000full | 100full | 100half | 10full | 10half}

no speed-duplex

1000full - Forces 1000 Mbps full-duplex operation

100full - Forces 100 Mbps full-duplex operation

100half - Forces 100 Mbps half-duplex operation

10full -Forces 10 Mbps full-duplex operation

10half -Forces 10 Mbps half-duplex operation

1000full operation cannot be forced. The Gigabit Combo ports can only operate at 1000full when auto-negotiation is enabled.

Default Setting

Auto-negotiation is enabled by default.

When auto-negotiation is disabled, the default speed-duplex setting for both 100BASE-TX and Gigabit Ethernet ports is 100full.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

To force operation to the speed and duplex mode specified in a speed-duplex command, use the no negotiation command to disable auto-negotiation on the selected interface.

When using the negotiation command to enable auto-negotiation, the optimal settings will be determined by the capabilities command. To set the speed/duplex mode under auto-negotiation, the required mode must be specified in the capabilities list for an interface.

Example

The following **Example** configures port 5 to 100 Mbps, half-duplex operation.

```
Console(config)#interface ethernet 1/5
Console(config-if)#speed-duplex 100half
Console(config-if)#no negotiation
Console(config-if)#
```

Related Commands

negotiation

capabilities

negotiation

This command enables autonegotiation for a given interface. Use the no form to disable autonegotiation.

Syntax

[no] negotiation

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When auto-negotiation is enabled the switch will negotiate the best settings for a link based on the capabilities command. When auto-negotiation is disabled, you must manually specify the link attributes with the speed-duplex and flowcontrol commands.

If autonegotiation is disabled, auto-MDI/MDI-X pin signal configuration will also be disabled for the RJ-45 ports.

Example

The following **Example** configures port 11 to use autonegotiation.

```
Console(config)#interface ethernet 1/11
Console(config-if)#negotiation
```

```
Console(config-if)#
```

Related Commands

capabilities

speed-duplex

capabilities

This command advertises the port capabilities of a given interface during autonegotiation. Use the no form with parameters to remove an advertised capability, or the no form without parameters to restore the default values.

Syntax

[no] capabilities {1000full | 100full | 100half | 10full | 10half | flowcontrol | symmetric}

- **1000full** - Supports 1000 Mbps full-duplex operation
- **100full** - Supports 100 Mbps full-duplex operation
- **100half** - Supports 100 Mbps half-duplex operation
- **10full** - Supports 10 Mbps full-duplex operation
- **10half** -Supports 10 Mbps half-duplex operation
- **flowcontrol** -Supports flow control
- **symmetric** (Gigabit only) - When specified, the port transmits and receives pause frames; when not specified, the port will auto-negotiate to determine the sender and receiver for asymmetric pause frames.

The current switch ASIC only supports symmetric pause frames

Default Setting

- 100BASE-TX: 10half, 10full, 100half, 100full
- 1000BASE-T: 10half, 10full, 100half, 100full, 1000full
- SFP: 1000full

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When auto-negotiation is enabled with the negotiation command, the switch will negotiate the best settings for a link based on the capabilites command. When auto-negotiation is disabled, you must manually specify the link attributes with the speed-duplex and flowcontrol commands.

Example

The following **Example** configures Ethernet port 5 capabilities to 100half, 100full and flow control.

```
Console(config)# interface ethernet 1/5
Console(config-if)# capabilities 100half
Console(config-if)# capabilities 100full
Console(config-if)# capabilities flowcontrol
Console(config-if)#
```

Related Commands

negotiation

speed-duplex

flowcontrol

flowcontrol

This command enables flow control. Use the no form to disable flow control.

Syntax

[no] flowcontrol

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3x for full-duplex operation.
- To force flow control on or off (with the flowcontrol or no flowcontrol command), use the no negotiation command to disable auto-negotiation on the selected interface.
- When using the negotiation command to enable auto-negotiation, the optimal settings will be determined by the capabilities command. To enable flow control under auto-negotiation, "flowcontrol" must be included in the capabilities list for any port
- Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.

Example

The following **Example** enables flow control on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#flowcontrol
```

```
Console(config-if)#no negotiation
Console(config-if)#
```

Related Commands

negotiation

capabilities (flowcontrol, symmetric)

shutdown

This command disables an interface. To restart a disabled interface, use the no form.

Syntax

[no] shutdown

Default Setting

All interfaces are enabled.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command allows you to disable a port due to abnormal behavior (e.g., excessive collisions), and then reenable it after the problem has been resolved. You may also want to disable a port for security reasons.

Example

The following **Example** disables port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#shutdown
Console(config-if)#
```

broadcast byte-rate

This command configures broadcast storm control threshold.

Syntax

broadcast byte-rate scale level level

scale – The threshold scale. (Options: 1, 10, 100, 1000 Kbytes per second)

level – The threshold level. (Range: 1-127)

Default Setting

Threshold Scale: 1000 Kbytes per second

Threshold Level: 5

Command Mode

Global Configuration

Command Usage

- When broadcast traffic exceeds the specified threshold, packets above that threshold are dropped.
- The scale and level are multiplied by one another to set the broadcast threshold. For example, to set a threshold of 500 Kbytes per second, choose 100K for the scale and 5 for the level.
- The specified threshold value applies to all ports on the switch.

Example

The following shows how to set the broadcast storm control threshold at 500 Kbytes per second:

```
Console(config)#broadcast byte-rate 100 level 5
Console(config)#
```

switchport broadcast

This command enables broadcast storm control on the specified interface. Use the no form to disable broadcast storm control.

Syntax

[no] switchport broadcast

Default Setting

Enabled for all ports

Command Mode

Interface Configuration (Ethernet)

Command Usage

This command enables or disables broadcast storm control for the selected interface. However, the threshold value, specified using the broadcast byte-rate command, applies to all ports on the switch.

Example

The following shows how to enable broadcast storm control for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#switchport broadcast
Console(config-if)#
```

clear counters

This command clears statistics on an interface.

Syntax

clear counters interface interface

- **ethernet** unit/port

  -unit - Stack unit. (Range: 1)

  -port - Port number. (Range: 1-28)

- **port-channel** channel-id (Range: 1-12)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Statistics are only initialized for a power reset. This command sets the base value for displayed statistics to zero for the current management session. However, if you log out and back into the management interface, the statistics displayed will show the absolute value accumulated since the last power reset.

Example

The following **Example** clears statistics on port 5.

```
Console#clear counters ethernet 1/5
Console#
```

show interfaces status

This command displays the status for an interface.

Syntax

show interfaces status [interface] interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

• vlan vlan-id (Range: 1-4094)

Default Setting

Shows the status for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed. For a description of the items displayed by this command, see "**Displaying Connection Status**".

Example

```
Console# show interfaces status ethernet 1/5
Information of Eth 1/5

 Basic Information:
 Port Type:              100TX
  Mac Address:           00-30-4F-10-22-A1
  Configuration:
  Name:
  Port Admin:            Up
  Speed-duplex:          Auto
  Capabilities:          10half, 10full, 100half, 100full
  Broadcast Storm:       Enabled
  Broadcast Storm Limit: scale:1000K level:5 octets/second
  Flow Control:          Disabled
  LACP:                  Disabled
  Port Security:         Disabled
  Max MAC Count:         0
  Port Security Action:  None
Current Status:
  Link Status:           Up
  Port Operation Status: Up
  Operation Speed-duplex: 100full
  Flow Control Type:     None

Console# show interfaces status vlan 1
 Information of VLAN 1
 MAC address:            00-30-4F-12-34-56
Console#
```

show interfaces counters

This command displays interface statistics.

Syntax

show interfaces counters [interface] interface

• ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

Shows the counters for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed. For a description of the items displayed by this command, see "**Showing Port Statistics**".

Example

```
Console#show interfaces counters ethernet 1/7
Ethernet 1/7

 Iftable stats:
   Octets input: 30658, Octets output: 196550
   Unicast input: 6, Unicast output: 5
   Discard input: 0, Discard output: 0
   Error input: 0, Error output: 0
   Unknown protos input: 0, QLen output: 0

 Extended iftable stats:
   Multi-cast input: 0, Multi-cast output: 3064
   Broadcast input: 262, Broadcast output: 1

 Ether-like stats:
   Alignment errors: 0, FCS errors: 0
   Single Collision frames: 0, Multiple collision frames: 0
   SQE Test errors: 0, Deferred transmissions: 0
   Late collisions: 0, Excessive collisions: 0
   Internal mac transmit errors: 0, Internal mac receive errors: 0
   Frame too longs: 0, Carrier sense errors: 0
   Symbol errors: 0

 RMON stats:
   Drop events: 0, Octets: 227208, Packets: 3338
   Broadcast pkts: 263, Multi-cast pkts: 3064
   Undersize pkts: 0, Oversize pkts: 0
   Fragments: 0, Jabbers: 0
   CRC align errors: 0, Collisions: 0
   Packet size <= 64 octets: 3150, Packet size 65 to 127 octets: 139
   Packet size 128 to 255 octets: 49, Packet size 256 to 511 octets: 0
   Packet size 512 to 1023 octets: 0, Packet size 1024 to 1518 octets: 0

Console#
```

show interfaces switchport

This command displays the administrative and operational status of the specified interfaces.

Syntax

show interfaces switchport [interface] interface

• ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

Shows all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

This **Example** shows the configuration setting for port 2.

```
Console#show interfaces switchport ethernet 1/2


Information of Eth 1/2
 Broadcast Threshold:         Enabled, scale:1000K level:5 octets/second
 LACP Status:                 Disabled
 Ingress Rate Limit:                  Disabled, scale:10M level:1
  Egress Rate Limit:                   Disabled, scale:10M level:1
 VLAN Membership Mode: Hybrid
 Ingress Rule:                Enabled
 Acceptable Frame Type:               All frames
 Native VLAN:                 1
 Priority for Untagged Traffic: 0
 GVRP Status:                 Disabled
 Allowed VLAN:                            1(u),4093(t),
 Forbidden VLAN:
 Private-VLAN Mode:       NONE
 Private-VLAN host-association: NONE
 Private-VLAN Mapping: NONE
 802.1Q-tunnel Status: Disable
```

```
802.1Q-tunnel Mode:     NORMAL
802.1Q-tunnel TPID:     8100(Hex)
Console#
```

Field	Description
Broadcast Threshold	Shows if broadcast storm suppression is enabled or disabled; if enabled it also shows the threshold level
LACP Status	Shows if Link Aggregation Control Protocol has been enabled or disabled
Ingress Rate Limit	Shows if ingress rate limiting is enabled, and the current rate limit.
Egress Rate Limit	Shows if egress rate limiting is enabled, and the current rate limit.
VLAN Membership Mode	Indicates membership mode as Trunk or Hybrid
Ingress Rule	Shows if ingress filtering is enabled or disabled. Note: Ingress filtering is always enabled.
Acceptable Frame Type	Shows if acceptable VLAN frames include all types or tagged frames only
Native VLAN	Indicates the default Port VLAN ID.
Priority for UntaggedTraffic	Indicates the default priority for untagged frames
GVRP Status	Shows if GARP VLAN Registration Protocol is enabled or disabled
Allowed VLAN	Shows the VLANs this interface has joined, where "(u)" indicates untagged and "(t)" indicates tagged
Forbidden VLAN	Shows the VLANs this interface can not dynamically join via GVRP
Private VLAN Mode	Shows the private VLAN mode as host, promiscuous, or none
Private VLAN Host-association	Shows the secondary (or community) VLAN with which this port is associated
Private VLAN Mapping	Shows the primary VLAN mapping for a promiscuous port
802.1Q-tunnel Status	Shows if 802.1Q tunnel is enabled on this interface
802.1Q-tunnel Mode	Shows the tunnel mode as Normal, 802.1Q Tunnel or 802.1Q Tunnel Uplink
802.1Q-tunnel TPID	Shows the Tag Protocol Identifier used for learning and switching packets

Table 5-53 Interfaces Switchport Statistics

5.16 Link Aggregation Commands

Ports can be statically grouped into an aggregate link (i.e., trunk) to increase the bandwidth of a network connection or to ensure fault recovery. Or you can use the Link Aggregation Control Protocol (LACP) to automatically negotiate a trunk link between this switch and another network device. For static trunks, the switches have to comply with the Cisco EtherChannel standard. For dynamic trunks, the switches have to comply with LACP. This switch supports up to four trunks. For **Example**, a trunk consisting of two 1000 Mbps ports can support an aggregate bandwidth of 4 Gbps when operating at full duplex.

Command	Function	Mode
Manual Configuration Commands		
interface port-channel	Configures a trunk and enters interface configuration mode for the trunk	GC
channel-group	Adds a port to a trunk	IC (Ethernet)
Dynamic Configuration Command		
lacp	Configures LACP for the current interface	IC (Ethernet)
lacp system-priority	Configures a port's LACP system priority	IC (Ethernet)
lacp admin-key	Configures a port's administration key	IC (Ethernet)
lacp admin-key	Configures an port channel's administration key	IC (Port Channel)
lacp port-priority	Configures a port's LACP port priority	IC (Ethernet)
Trunk Status Display Command		
show interfaces status port-channel	Shows trunk information	NE, PE
show lacp	Shows LACP information	PE

Table 5-54 Link Aggregation Commands

Guidelines for Creating Trunks

General Guidelines –

Finish configuring port trunks before you connect the corresponding network cables between switches to avoid creating a loop.

A trunk can have up to eight ports.

The ports at both ends of a connection must be configured as trunk ports.

All ports in a trunk must be configured in an identical manner, including communication mode (i.e., speed, duplex mode and flow control), VLAN assignments, and CoS settings.

Any of the SFP transceivers can be trunked together, including those of different media types.

All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN via the specified port-channel.

STP, VLAN, and IGMP settings can only be made for the entire trunk via the specified port-channel.

Dynamically Creating a Port Channel –

Ports assigned to a common port channel must meet the following criteria:

Ports must have the same LACP system priority.

Ports must have the same port admin key (Ethernet Interface).

If the port channel admin key (lacp admin key -Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (lacp admin key -Ethernet Interface) used by the interfaces that joined the group.

However, if the port channel admin key is set, then the port admin key must be set to the same value for a port to be allowed to join a channel group.

If a link goes down, LACP port priority is used to select the backup link.

channel-group

This command adds a port to a trunk. Use the no form to remove a port from a trunk.

Syntax

channel-group channel-id

no channel-group

channel-id - Trunk index (Range: 1-12)

Default Setting

The current port will be added to this trunk.

Command Mode

Interface Configuration (Ethernet)

Command Usage

When configuring static trunks, the switches must comply with the Cisco EtherChannel standard.

Use no channel-group to remove a port group from a trunk.

Use no interfaces port-channel to remove a trunk from the switch.

Example

The following **Example** creates trunk 1 and then adds port 11:

```
Console(config)#interface port-channel 1
Console(config-if)#exit
Console(config)#interface ethernet 1/11
Console(config-if)#channel-group 1
Console(config-if)#
```

lacp

This command enables 802.3ad Link Aggregation Control Protocol (LACP) for the current interface. Use the no form to disable

it.

Syntax

[no] lacp

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

The ports on both ends of an LACP trunk must be configured for full duplex, and auto-negotiation.

A trunk formed with another switch using LACP will automatically be assigned the next available port-channel ID.

If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.

If more than eight ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.

Example

The following shows LACP enabled on ports 11-13. Because LACP has also been enabled on the ports at the other end of the links, the show interfaces status port-channel 1 command shows that Trunk 1 has been established.

```
Console(config)#interface ethernet 1/11
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#interface ethernet 1/12
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#interface ethernet 1/13
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#exit
Console#show interfaces status port-channel 1

 Information of Trunk 1
  Basic information:
    Port type:              100TX
    Mac address:            00-30-4F-12-34-72
  Configuration:
    Name:
    Port admin:             Up
    Speed-duplex:           Auto
    Capabilities:           10half, 10full, 100half, 100full
```

```
  Flow control
                        Disabled
status:
  Port security:        Disabled
  Max MAC count:        0
 Current status:
  Created by:           LACP
  Link status:          Up
 Operation speed-duplex: 100full
 Flow control type:     None
 Member Ports: Eth1/11, Eth1/12, Eth1/13,


Console#
```

lacp system-priority

This command configures a port's LACP system priority. Use the no form to restore the Default Setting.

Syntax

lacp {actor | partner} system-priority priority

no lacp {actor | partner} system-priority

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

priority -This priority is used to determine link aggregation group (LAG) membership, and to identify this device to other switches during LAG negotiations. (Range: 0-65535)

Default Setting

32768

Command Mode

Interface Configuration (Ethernet)

Command Usage

Port must be configured with the same system priority to join the same LAG.

System priority is combined with the switch's MAC address to form the LAG identifier. This identifier is used to indicate a specific LAG during LACP negotiations with other systems.

Once the remote side of a link has been established, LACP operational settings are already in use on that side.

Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor system-priority 3
Console(config-if)#
```

lacp admin-key (Ethernet Interface)

This command configures a port's LACP administration key. Use the no form to restore the Default Setting.

Syntax

lacp {actor | partner} admin-key key

[no] lacp {actor | partner} admin-key

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

key - The port admin key must be set to the same value for ports that belong to the same link aggregation group (LAG). (Range: 0-65535)

Default Setting

0

Command Mode

Interface Configuration (Ethernet)

Command Usage

Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).

If the port channel admin key (lacp admin key - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (lacp admin key - Ethernet Interface) used by the interfaces that joined the group.

Once the remote side of a link has been established, LACP operational settings are already in use on that side.

Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor admin-key 120
Console(config-if)#
```

lacp admin-key (Port Channel)

This command configures a port channel's LACP administration key string. Use the no form to restore the Default Setting.

Syntax

lacp {actor | partner} admin-key key

[no] lacp {actor | partner} admin-key

key -The port channel admin key is used to identify a specific link aggregation group (LAG) during local LACP setup on this switch. (Range: 0-65535)

Default Setting

0

Command Mode

Interface Configuration (Port Channel)

Command Usage

Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).

If the port channel admin key (lacp admin key - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (lacp admin key - Ethernet Interface) used by the interfaces that joined the group. Note that when the LAG is no longer used, the port channel admin key is reset to 0.

Example

```
Console(config)#interface port-channel 1
Console(config-if)#lacp actor admin-key 3
Console(config-if)#
```

lacp port-priority

This command configures LACP port priority. Use the no form to restore the Default Setting.

Syntax

lacp {actor | partner} port-priority priority

no lacp {actor | partner} port-priority

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

priority - LACP port priority is used to select a backup link.

(Range: 0-65535)

Default Setting

32768

Command Mode

Interface Configuration (Ethernet)

Command Usage

Setting a lower value indicates a higher effective priority.

If an active port link goes down, the backup port with the highest priority is selected to replace the downed link. However, if two or more ports have the same LACP port priority, the port with the lowest physical port number will be selected as the backup port.

Once the remote side of a link has been established, LACP operational settings are already in use on that side.

Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor port-priority 128
```

show lacp

This command displays LACP information.

Syntax

show lacp [port-channel] {counters | internal | neighbors | sysid}

port-channel -Local identifier for a link aggregation group. (Range: 1-12)

counters - Statistics for LACP protocol messages.

internal - Configuration settings and operational state for local side.

neighbors - Configuration settings and operational state for remote side.

sysid -Summary of system priority and MAC address for all channel groups.

Default Setting

Port Channel: all

Command Mode

Privileged Exec

Example

```
Console#show lacp 1 counters
Port channel : 1


Eth 1/ 1
```

```
   LACPDUs Sent : 21
   LACPDUs Received : 21
   Marker Sent : 0
   Marker Received : 0
   LACPDUs Unknown Pkts : 0
   LACPDUs Illegal Pkts : 0

.

.

.
```

Field	Description
LACPDUs Sent	Number of valid LACPDUs transmitted from this channel group.
LACPDUs Received	Number of valid LACPDUs received on this channel group.
Marker Sent	Number of valid Marker PDUs transmitted from this channel group.
Marker Received	Number of valid Marker PDUs received by this channel group.
LACPDUs Unknown Pkts	Number of frames received that either (1) Carry the Slow Protocols Ethernet Type value, but contain an unknown PDU, or (2) are addressed to the Slow Protocols group MAC Address, but do not carry the Slow Protocols Ethernet Type.
LACPDUs Illegal Pkts	Number of frames that carry the Slow Protocols Ethernet Type value, but contain a badly formed PDU or an illegal value of Protocol Subtype.

Table 5-55 show lacp counters - display description

```
Console#show lacp 1 internal
Port channel : 1
Oper Key : 4
Admin Key : 0
Eth 1/1
   LACPDUs Internal : 30 sec
   LACP System Priority : 32768
   LACP Port Priority : 32768
   Admin Key : 4
```

```
Oper Key : 4
Admin State : defaulted, aggregation, long timeout, LACP-activity
Oper State : distributing, collecting, synchronization, aggregation,
             long timeout, LACP-activity
```

Field	Description
Oper Key	Current operational value of the key for the aggregation port.
Admin Key	Current administrative value of the key for the aggregation port.
LACPDUs Internal	Number of seconds before invalidating received LACPDU information.
LACP System Priority	LACP system priority assigned to this port channel.
LACP Port Priority	LACP port priority assigned to this interface within the channel group.
Admin State,Oper State	Administrative or operational values of the actor's state parameters: • Expired – The actor's receive machine is in the expired state; • Defaulted – The actor's receive machine is using defaulted operational partner information, administratively configured for the partner. • Distributing – If false, distribution of outgoing frames on this link is disabled; i.e., distribution is currently disabled and is not expected to be enabled in the absence of administrative changes or changes in received protocol information. • Collecting – Collection of incoming frames on this link is enabled; i.e., collection is currently enabled and is not expected to be disabled in the absence of administrative changes or changes in received protocol information. • Synchronization – The System considers this link to be IN_SYNC; i.e., it has beenallocated to the correct Link Aggregation Group, the group has been associatedwith a compatible Aggregator, and the identity of the Link Aggregation Group is consistent with the System ID and operational Key information transmitted. • Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation. • Long timeout – Periodic transmission of LACPDUs uses a slow transmission rate. • LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)

Table 5-56 show lacp internal - display description

```
Console#show lacp 1 neighbors
Port channel 1 neighbors

Eth 1/1
```

```
Partner Admin System ID:  32768, 00-00-00-00-00-00
Partner Oper System ID:  32768, 00-01-F4-78-AE-C0
Partner Admin Port Number: 2
Partner Oper Port Number:  2
Port Admin Priority: 32768
Port Oper Priority:  32768
Admin Key:                0
Oper Key:                 3
Admin State:                defaulted, distributing, collecting,
    synchronization, long timeout,
Oper State:                 distributing, collecting,
    synchronization, aggregation,
    long timeout, LACP-activity
```

Field	Description
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.
Partner Admin Port Number	Current administrative value of the port number for the protocol Partner.
Partner OperPort Number	Operational port number assigned to this aggregation port by the port's protocol partner.
Port Admin Priority	Current administrative value of the port priority for the protocol partner.
Port Oper Priority	Priority value assigned to this aggregation port by the partner.
Admin Key	Current administrative value of the Key for the protocol partner.
Oper Key	Current operational value of the Key for the protocol partner.
Admin State	Administrative values of the partner's state parameters. (See preceding table.)
Oper State	Operational values of the partner's state parameters. (See preceding table.)

Table 5-57 show lacp neighbors - display description

```
Console#show lacp sysid
Port Channel  System Priority  System MAC Address

1 32768 00-30-4F-8F-2C-A7
 2 32768 00-30-4F-8F-2C-A7
 3 32768 00-30-4F-8F-2C-A7
```

```
4 32768 00-30-4F-8F-2C-A7

Console#
```

Field	Description
Channel group	A link aggregation group configured on this switch.
System Priority*	LACP system priority for this channel group.
System MAC Address*	System MAC address.

Table 5-58 show lacp sysid - display description

* The LACP system priority and system MAC address are concatenated to form the LAG system ID.

5.17 Mirror Port Commands

This section describes how to mirror traffic from a source port to a target port.

Command	Function	Mode
port monitor	Configures a mirror session	IC
show port monitor	Shows the configuration for a mirror port	PE

Table 5-59 Mirror Port Commands

port monitor

This command configures a mirror session. Use the no form to clear a mirror session.

Syntax

port monitor interface [rx | tx | both]

no port monitor interface

interface -ethernet unit/port (source port)

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

rx - Mirror received packets.

tx - Mirror transmitted packets.

both - Mirror both received and transmitted packets.

Default Setting

No mirror session is defined. When enabled, the default mirroring is for both received and transmitted packets.

Command Mode

Interface Configuration (Ethernet, destination port)

Command Usage

You can mirror traffic from any source port to a destination port for real-time analysis. You can then attach a logic analyzer or RMON probe to the destination port and study the traffic crossing the source port in a completely unobtrusive manner.

The destination port is set by specifying an Ethernet interface.

The mirror port and monitor port speeds should match, otherwise traffic may be dropped from the monitor port.

You can create multiple mirror sessions, but all sessions must share the same destination port. However, you should avoid sending too much traffic to the destination port from multiple source ports.

Example

The following **Example** configures the switch to mirror all packets from port 6 to 11:

```
Console(config)#interface ethernet 1/11
```

```
Console(config-if)#port monitor ethernet 1/6 both
Console(config-if)#
```

show port monitor

This command displays mirror information.

Syntax

show port monitor [interface] interface -ethernet unit/port (source port)

unit - Stack unit. (Range: 1)

port - Port number. (Range: 1-28)

Default Setting

Shows all sessions.

Command Mode

Privileged Exec

Command Usage

This command displays the currently configured source port, destination port, and mirror mode (i.e., RX, TX, RX/TX).

Example

The following shows mirroring configured from port 6 to port 11:

```
Console(config)#interface ethernet 1/11
Console(config-if)#port monitor ethernet 1/6 rx
Console(config-if)#end
Console#show port monitor
Port Mirroring

 Destination port(listen port):Eth1/11
 Source port(monitored port)    :Eth1/6
 Mode :RX

Console#
```

5.18 Rate Limit Commands

This function allows the network manager to control the maximum rate for traffic received on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into the network. Packets that exceed the acceptable amount of traffic are dropped.

Rate limiting can be applied to individual ports. When an interface is configured with this feature, the traffic rate will be monitored

by the hardware to verify conformity. Non-conforming traffic is dropped.

Command	Function	Mode
rate-limit	Configures the maximum input or output rate for a port	IC

Table 5-60 Rate Limit Commands

rate-limit

This command define the rate limit for a specific interface. Use the no form to restore the default status of disabled.

Syntax

rate-limit {input | output} scale {1k | 10k | 100k | 1m | 10m} level level no rate-limit {input | output}

input – Input rate limit

• output – Output rate limit

scale – The traffic rate limit scale. (Options: 1K, 10K, 100K, 1M, or 10M bytes per second)

level – The traffic rate limit level. (Range: 1-127)

Default Setting

Status: Disabled

Scale: 10M bytes per second

Level: 1

Command Mode

Interface Configuration (Ethernet)

Command Usage

The scale and level are multiplied by one another to set the rate limit. For **Example**, to limit port traffic to 500K bytes per second, select the scale as 100K and set the level to 5.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rate-limit input scale 100k level 5
Console(config-if)#
```

5.19 Address Table Commands

These commands are used to configure the address table for filtering specified addresses, displaying current entries, clearing the table, or setting the aging time.

Command	Function	Mode
mac-address-table static	Maps a static address to a port in a VLAN	GC
clear mac-address-table dynamic	Removes any learned entries from the forwarding database	PE
show mac-address-table	Displays entries in the bridge-forwarding database	PE
mac-address-table aging-time	Sets the aging time of the address table	GC
show mac-address-table aging-time	Shows the aging time for the address table	PE

Table 5-61 Address Table Commands

mac-address-table static

This command maps a static address to a destination port in a VLAN. Use the no form to remove an address.

Syntax

mac-address-table static mac-address interface interface

vlan vlan-id [action]

no mac-address-table static mac-address vlan vlan-id

mac-address - MAC address.

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

vlan-id -VLAN ID (Range: 1-4094)

action --delete-on-reset - Assignment lasts until the switch is reset. -permanent - Assignment is permanent.

Default Setting

No static addresses are defined. The default mode is permanent.

Command Mode

Global Configuration

Command Usage

The static address for a host device can be assigned to a specific port within a specific VLAN. Use this command to add static addresses to the MAC Address Table. Static addresses have the following characteristics:

Static addresses will not be removed from the address table when a given interface link is down.

Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.

A static address cannot be learned on another port until the address is removed with the no form of this command.

Example

```
Console(config)#mac-address-table static 00-30-4F-94-34-de interface
ethernet 1/1 vlan 1 delete-on-reset

Console(config)#
```

clear mac-address-table dynamic

This command removes any learned entries from the forwarding database and clears the transmit and receive counts for any static or system configured entries.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#clear mac-address-table dynamic
Console#
```

show mac-address-table

This command shows classes of entries in the bridge-forwarding database.

Syntax

show mac-address-table [address mac-address [mask]] [interface interface] [vlan vlan-id] [sort {address | vlan | interface}]

mac-address - MAC address.

mask - Bits to match in the address.

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-26)

port-channel channel-id (Range: 1-12)

vlan-id -VLAN ID (Range: 1-4094)

sort - Sort by address, vlan or interface.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

The MAC Address Table contains the MAC addresses associated with each interface. Note that the Type field may include the following types: -Learned - Dynamic address entries -Permanent - Static entry -Delete-on-reset - Static entry to be deleted when system is reset

The mask should be hexadecimal numbers (representing an equivalent bit mask) in the form xx-xx-xx-xx-xx-xx that is applied to the specified MAC address. Enter hexadecimal numbers, where an equivalent binary bit "0" means to match a bit and "1" means to ignore a bit. For **Example**, a mask of 00-00-00-00-00-00 means an exact match, and a mask of FF-FF-FF-FF-FF-FF means "any."

The maximum number of address entries is 8191.

Example

```
Console#show mac-address-table

 Interface Mac Address Vlan Type

 --------- ----------------- ---- ----------------

  Eth 1/1 00-30-4F-94-34-de    1 Delete-on-reset

  Trunk 2 00-30-4F-8f-aa-1b    1 Learned
Console#
```

mac-address-table aging-time

This command sets the aging time for entries in the address table. Use the no form to restore the default aging time.

Syntax

mac-address-table aging-time seconds

no mac-address-table aging-time

seconds - Aging time. (Range: 10-98301 seconds; 0 to disable aging)

Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

The aging time is used to age out dynamically learned forwarding information.

Example

```
Console(config)#mac-address-table aging-time 100
Console(config)#
```

show mac-address-table aging-time

This command shows the aging time for entries in the address table.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show mac-address-table aging-time
 Aging time: 100 sec.

Console#
```

5.20 Spanning Tree Commands

This section includes commands that configure the Spanning Tree Algorithm (STA) globally for the switch, and commands that configure STA for the selected interface.

Command	Function	Mode
spanning-tree	Enables the spanning tree protocol	GC
spanning-tree mode	Configures STP, RSTP or MSTP mode	GC
spanning-tree forward-time	Configures the spanning tree bridge forward time	GC
spanning-tree hello-time	Configures the spanning tree bridge hello time	GC
spanning-tree max-age	Configures the spanning tree bridge maximum age	GC
spanning-tree priority	Configures the spanning tree bridge priority	GC
spanning-tree path-cost method	Configures the path cost method for RSTP/MSTP	GC
spanning-tree transmission-limit	Configures the transmission limit for RSTP/MSTP	GC
spanning-tree mst-configuration	Changes to MSTP configuration mode	GC
mst vlan	Adds VLANs to a spanning tree instance	MST

mst priority	Configures the priority of a spanning tree instance	MST
name	Configures the name for the multiple spanning tree	MST
revision	Configures the revision number for the multiple spanning tree	MST
max-hops	Configures the maximum number of hops allowed in the region before a BPDU is discarded	MST
spanning-tree spanning-disabled	Disables spanning tree for an interface	IC
spanning-tree cost	Configures the spanning tree path cost of an interface	IC
spanning-tree port-priority	Configures the spanning tree priority of an interface	IC
spanning-tree edge-port	Enables fast forwarding for edge ports	IC
spanning-tree portfast	Sets an interface to fast forwarding	IC
spanning-tree link-type	Configures the link type for RSTP/MSTP	IC
spanning-tree mst cost	Configures the path cost of an instance in the MST	IC
spanning-tree mst port-priority	Configures the priority of an instance in the MST	IC
spanning-tree protocol-migration	Re-checks the appropriate BPDU format	PE
show spanning-tree	Shows spanning tree configuration for the common spanning tree (i.e., overall bridge), a selected interface, oran instance within the multiple spanning tree	PE
show spanning-tree mst configuration	Shows the multiple spanning tree configuration	PE

Table 5-62 Spanning Tree Commands

spanning-tree

This command enables the Spanning Tree Algorithm globally for the switch. Use the no form to disable it.

Syntax

[no] spanning-tree

Default Setting

Spanning tree is enabled.

Command Mode

Global Configuration

Command Usage

The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only one route exists between any two stations on the network, and provide backup links which automatically take over when a primary link goes down.

Example

This **Example** shows how to enable the Spanning Tree Algorithm for the switch:

```
Console(config)#spanning-tree
Console(config)#
```

spanning-tree mode

This command selects the spanning tree mode for this switch. Use the no form to restore the default.

MSTP is not supported in the current software.

Syntax

spanning-tree mode {stp | rstp | mstp} no spanning-tree mode

stp - Spanning Tree Protocol (IEEE 802.1D)

rstp - Rapid Spanning Tree Protocol (IEEE 802.1w)

mstp - Multiple Spanning Tree (IEEE 802.1s)

Default Setting

rstp

Command Mode

Global Configuration

Command Usage

• Spanning Tree Protocol Uses RSTP for the internal state machine, but sends only 802.1D BPDUs. This creates one spanning tree instance for the entire network. If multiple VLANs are implemented on a network, the path between specific VLAN members may be inadvertently disabled to prevent network loops, thus
isolating group members. When operating multiple VLANs, we recommend selecting the MSTP option.
Rapid Spanning Tree Protocol RSTP supports connections to either STP or RSTP nodes by monitoring the incoming protocol messages and dynamically adjusting the type of protocol messages the RSTP node transmits, as described below: -STP Mode – If the switch receives an 802.1D BPDU after a port's migration
delay timer expires, the switch assumes it is connected to an 802.1D bridge and starts using only 802.1D BPDUs.
- RSTP Mode – If RSTP is using 802.1D BPDUs on a port and receives an RSTP BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.
• Multiple Spanning Tree Protocol -To allow multiple spanning trees to operate over the network, you must configure a related set of bridges with the same MSTP configuration, allowing them to participate in a specific set of spanning tree instances. -A spanning tree instance can exist only on bridges that have compatible VLAN instance assignments. -Be

careful when switching between spanning tree modes. Changing modes

stops all spanning-tree instances for the previous mode and restarts the system in the new mode, temporarily disrupting user traffic.

Example

The following **Example** configures the switch to use Rapid Spanning Tree:

```
Console(config)#spanning-tree mode rstp
Console(config)#
```

spanning-tree forward-time

This command configures the spanning tree bridge forward time globally for this switch. Use the no form to restore the default.

Syntax

spanning-tree forward-time seconds

no spanning-tree forward-time

seconds - Time in seconds. (Range: 4 -30 seconds) The minimum value is the higher of 4 or [(max-age / 2) + 1].

Default Setting

15 seconds

Command Mode

Global Configuration

Command Usage

This command sets the maximum time (in seconds) the root device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to the discarding state; otherwise, temporary data loops might result.

Example

```
Console(config)#spanning-tree forward-time 20
Console(config)#
```

spanning-tree hello-time

This command configures the spanning tree bridge hello time globally for this switch. Use the no form to restore the default.

Syntax

spanning-tree hello-time time no spanning-tree hello-time

time - Time in seconds. (Range: 1-10 seconds). The maximum value is the lower of 10 or [(max-age / 2) -1].

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

This command sets the time interval (in seconds) at which the root device transmits a configuration message.

Example

```
Console(config)#spanning-tree hello-time 5
Console(config)#
```

Related Commands

spanning-tree forward-time

spanning-tree max-age

spanning-tree max-age

This command configures the spanning tree bridge maximum age globally for this switch. Use the no form to restore the default.

Syntax

spanning-tree max-age seconds no spanning-tree max-age

seconds - Time in seconds. (Range: 6-40 seconds)

The minimum value is the higher of 6 or [2 x (hello-time + 1)].

The maximum value is the lower of 40 or [2 x (forward-time -1)].

Default Setting

20 seconds

Command Mode

Global Configuration

Command Usage

This command sets the maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network.

Example

```
Console(config)#spanning-tree max-age 40
Console(config)#
```

Related Commands

spanning-tree forward-time

spanning-tree hello-time

spanning-tree priority

This command configures the spanning tree priority globally for this switch. Use the no form to restore the default.

Syntax

spanning-tree priority priority no spanning-tree priority

priority -Priority of the bridge. (Range: 0 -65535)

(Range – 0-61440, in steps of 4096; Options: 0, 4096, 8192, 12288,

16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152,

53248, 57344, 61440)

Default Setting

32768

Command Mode

Global Configuration

Command Usage

Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority (i.e., lower numeric value) becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

Example

```
Console(config)#spanning-tree priority 40000
Console(config)#
```

spanning-tree pathcost method

This command configures the path cost method used for Rapid Spanning Tree and Multiple Spanning Tree. Use the no form to restore the default.

Syntax

spanning-tree pathcost method {long | short} no spanning-tree pathcost method

long -Specifies 32-bit based values that range from 1-200,000,000. This method is based on the IEEE 802.1w Rapid Spanning Tree Protocol.

short - Specifies 16-bit based values that range from 1-65535. This method is based on the IEEE 802.1 Spanning Tree Protocol.

Default Setting

Long method

Command Mode

Global Configuration

Command Usage

The path cost method is used to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Note that path cost (page 4-211) takes precedence over port priority (page 4-213).

Example

```
Console(config)#spanning-tree pathcost method long
Console(config)#
```

spanning-tree transmission-limit

This command configures the minimum interval between the transmission of consecutive RSTP/MSTP BPDUs. Use the no form to restore the default.

Syntax

spanning-tree transmission-limit count no spanning-tree transmission-limit

count - The transmission limit in seconds. (Range: 1-10)

Default Setting

3

Command Mode

Global Configuration

Command Usage

This command limits the maximum transmission rate for BPDUs.

Example

```
Console(config)#spanning-tree transmission-limit 4
Console(config)#
```

spanning-tree mst-configuration

This command changes to Multiple Spanning Tree (MST) configuration mode.

Default Setting

No VLANs are mapped to any MST instance.

The region name is set the switch's MAC address.

Command Mode

Global Configuration

Example

```
Console(config)#spanning-tree mst configuration
Console(config-mstp)#
```

Related Commands

mst vlan

mst priority

name

revision

max-hops

mst vlan

This command adds VLANs to a spanning tree instance. Use the no form to remove the specified VLANs. Using the no form without any VLAN parameters to remove all VLANs.

Syntax

[no] mst instance_id vlan vlan-range

instance_id - Instance identifier of the spanning tree. (Range: 0-4094)

vlan-range - Range of VLANs. (Range: 1-4094)

Default Setting

none

Command Mode

MST Configuration

Command Usage

Use this command to group VLANs into spanning tree instances. MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

By default all VLANs are assigned to the Internal Spanning Tree (MSTI 0) that connects all bridges and LANs within the MST region. This switch supports up to 58 instances. You should try to group VLANs which cover the same general area of your network. However, remember that you must configure all bridges within the same MSTI Region with the same set of instances, and the same instance (on each bridge) with the same set of VLANs. Also, note that RSTP treats each MSTI region as a single node, connecting all regions to the Common Spanning Tree.

Example

```
Console(config-mstp)#mst 1 vlan 2-5
```

```
Console(config-mstp)#
```

mst priority

This command configures the priority of a spanning tree instance. Use the no form to restore the default.

Syntax

mst instance_id priority priority no mst instance_id priority

instance_id - Instance identifier of the spanning tree. (Range: 0-4094)

priority - Priority of the a spanning tree instance. (Range: 0-61440 in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

Default Setting

32768

Command Mode

MST Configuration

Command Usage

MST priority is used in selecting the root bridge and alternate bridge of the specified instance. The device with the highest priority (i.e., lowest numerical value) becomes the MSTI root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

You can set this switch to act as the MSTI root device by specifying a priority of 0, or as the MSTI alternate device by specifying a priority of 16384.

Example

```
Console(config-mstp)#mst 1 priority 4096
Console(config-mstp)#
```

name

This command configures the name for the multiple spanning tree region in which this switch is located. Use the no form to clear the name.

Syntax

name name name - Name of the spanning tree.

Default Setting

Switch's MAC address

Command Mode

MST Configuration

Command Usage

The MST region name and revision number (page 4-210) are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

Example

```
Console(config-mstp)#name R&D
Console(config-mstp)#
```

Related Commands

revision

revision

This command configures the revision number for this multiple spanning tree configuration of this switch. Use the no form to restore the default.

Syntax

revision number number -Revision number of the spanning tree. (Range: 0-65535)

Default Setting

0

Command Mode

MST Configuration

Command Usage

The MST region name (page 4-209) and revision number are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

Example

```
Console(config-mstp)#revision 1
Console(config-mstp)#
```

Related Commands

name

max-hops

This command configures the maximum number of hops in the region before a BPDU is discarded. Use the no form to restore the default.

Syntax

max-hops hop-number hop-number -Maximum hop number for multiple spanning tree. (Range: 1-40)

Default Setting

20

Command Mode

MST Configuration

Command Usage

An MSTI region is treated as a single node by the STP and RSTP protocols. Therefore, the message age for BPDUs inside an MSTI region is never changed. However, each spanning tree instance within a region, and the internal spanning tree (IST) that connects these instances use a hop count to specify the maximum number of bridges that will propagate a BPDU. Each bridge decrements the hop count by one before passing on the BPDU. When the hop count reaches zero, the message is dropped.

Example

```
Console(config-mstp)#max-hops 30
Console(config-mstp)#
```

spanning-tree spanning-disabled

This command disables the spanning tree algorithm for the specified interface. Use the no form to reenable the spanning tree algorithm for the specified interface.

Syntax

[no] spanning-tree spanning-disabled

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

This example disables the spanning tree algorithm for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree spanning-disabled
Console(config-if)#
```

spanning-tree cost

This command configures the spanning tree path cost for the specified interface. Use the no form to restore the default.

Syntax

spanning-tree cost cost no spanning-tree cost

(Range: 0 for auto-configuration, 1-65535 for short path cost method23, 1-200,000,000 for long path cost method)

Port Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Ethernet	50-600	200,000-20,000,000
Fast Ethernet	10-60	20,000-2,000,000
Gigabit Ethernet	3-10	2,000-200,000

Table 5-63 Recommended STA Path Cost Range

Use the spanning-tree pathcost method command on page 4-206 to set the path cost method.

Port Type	Link Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Ethernet	Half	100	2,000,000
	DuplexFull	95	1,999,999
	DuplexTrunk	90	1,000,000
Fast Ethernet	Half	19	200,000
	DuplexFull	18	100,000
	DuplexTrunk	15	50,000
Gigabit Ethernet	Full	4	10,000
	DuplexTrunk	3	5,000

Table 5-64 Recommended STA Path Cost

Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

Port Type	Link Type	IEEE 802.1w-2001
Ethernet	Half Duplex	2,000,000
	Full Duplex	1,000,000
	Trunk	500,000
Fast Ethernet	Half Duplex	200,000
	Full Duplex	100,000
	Trunk	50,000

Gigabit Ethernet	Full Duplex	10,000
	Trunk	5,000

Table 5-65 Default STA Path Costs

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command is used by the Spanning Tree Algorithm to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Path cost takes precedence over port priority.

When the spanning-tree pathcost method (page 4-206) is set to short, the maximum value for path cost is 65,535.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree cost 50
Console(config-if)#
```

spanning-tree port-priority

This command configures the priority for the specified interface. Use the no form to restore the default.

Syntax

spanning-tree port-priority priority no spanning-tree port-priority

priority - The priority for a port. (Range: 0-240, in steps of 16)

Default Setting

128

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command defines the priority for the use of a port in the Spanning Tree Algorithm. If the path cost for all ports on a switch are the same, the port with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.

Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-priority 0
```

Related Commands

spanning-tree cost

spanning-tree edge-port

This command specifies an interface as an edge port. Use the no form to restore the default.

Syntax

[no] spanning-tree edge-port

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

• You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes cannot cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device.

• This command has the same effect as the spanning-tree portfast.

Example

```
Console(config)#interface ethernet ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#
```

Related Commands

spanning-tree portfast

spanning-tree portfast

This command sets an interface to fast forwarding. Use the no form to disable fast forwarding.

Syntax

[no] spanning-tree portfast

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command is used to enable/disable the fast spanning-tree mode for the selected port. In this mode, ports skip the Discarding and Learning states, and proceed straight to Forwarding.

Since end-nodes cannot cause forwarding loops, they can be passed through the spanning tree state changes more quickly than allowed by standard convergence time. Fast forwarding can achieve quicker convergence for end-node workstations and servers, and also overcome other STA related timeout problems. (Remember that fast forwarding should only be enabled for ports connected to a LAN segment that is at the end of a bridged LAN or for an end-node device.)

This command is the same as spanning-tree edge-port, and is only included for backward compatibility with earlier products. Note that this command may be removed for future software versions.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#bridge-group 1 portfast
Console(config-if)#
```

Related Commands

spanning-tree edge-port

spanning-tree link-type

This command configures the link type for Rapid Spanning Tree and Multiple Spanning Tree. Use the no form to restore the default.

Syntax

spanning-tree link-type {auto | point-to-point | shared} no spanning-tree link-type

auto -Automatically derived from the duplex mode setting.

point-to-point - Point-to-point link.

shared - Shared medium.

Default Setting

auto

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Specify a point-to-point link if the interface can only be connected to exactly one other bridge, or a shared link if it can be

connected to two or more bridges.

When automatic detection is selected, the switch derives the link type from the duplex mode. A full-duplex interface is considered a point-to-point link, while a half-duplex interface is assumed to be on a shared link.

RSTP only works on point-to-point links between two bridges. If you designate a port as a shared link, RSTP is forbidden. Since MSTP is an extension of RSTP, this same restriction applies.

Example

```
Console(config)#interface ethernet ethernet 1/5
Console(config-if)#spanning-tree link-type point-to-point
Console(config-if)#
```

spanning-tree mst cost

This command configures the path cost on a spanning instance in the Multiple Spanning Tree. Use the no form to restore the default.

Syntax

spanning-tree mst instance_id cost cost no spanning-tree mst instance_id cost

instance_id - Instance identifier of the spanning tree.

(Range: 0-4094, no leading zeroes)

cost - Path cost for an interface.

(Range: 0 for auto-configuration, 1-65535 for short path cost method24, 1-200,000,000 for long path cost method)

The recommended path cost range is listed in Table 4-63 on page 4-211. The recommended path cost is listed in Table 4-64 on page 4-212.

Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535. The default path costs are listed in Table 5-65

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Each spanning-tree instance is associated with a unique set of VLAN IDs.

This command is used by the multiple spanning-tree algorithm to determine the best path between devices. Therefore, lower values should be assigned to interfaces attached to faster media, and higher values assigned to interfaces with slower media.

Use the no spanning-tree mst cost command to specify auto-configuration mode.

Path cost takes precedence over interface priority.

Example

```
Console(config)#interface ethernet ethernet 1/5
Console(config-if)#spanning-tree mst 1 cost 50
Console(config-if)#
```

Related Commands

spanning-tree mst port-priority

Use the spanning-tree pathcost method command on page 4-206 to set the path cost method.

spanning-tree mst port-priority

This command configures the interface priority on a spanning instance in the Multiple Spanning Tree. Use the no form to restore the default.

Syntax

spanning-tree mst instance_id port-priority priority no spanning-tree mst instance_id port-priority

instance_id - Instance identifier of the spanning tree.

(Range: 0-4094, no leading zeroes)

priority -Priority for an interface. (Range: 0-240 in steps of 16)

Default Setting

128

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command defines the priority for the use of an interface in the multiple spanning-tree. If the path cost for all interfaces on a switch are the same, the interface with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.

Where more than one interface is assigned the highest priority, the interface with lowest numeric identifier will be enabled.

Example

```
Console(config)#interface ethernet ethernet 1/5
Console(config-if)#spanning-tree mst 1 port-priority 0
Console(config-if)#
```

Related Commands

spanning-tree mst cost

spanning-tree protocol-migration

This command re-checks the appropriate BPDU format to send on the selected interface.

Syntax

spanning-tree protocol-migration interface

interface ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Command Usage

If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the spanning-tree protocol-migration command at any time to manually re-check the appropriate BPDU format to send on the selected interfaces (i.e., RSTP or STP-compatible).

Example

```
Console#spanning-tree protocol-migration eth 1/5
Console#
```

show spanning-tree

This command shows the configuration for the common spanning tree (CST) or for an instance within the multiple spanning tree (MST).

Syntax

show spanning-tree [interface | mst instance_id]

• interface ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

instance_id - Instance identifier of the multiple spanning tree. (Range: 0-4094, no leading zeroes)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Use the show spanning-tree command with no parameters to display the spanning tree configuration for the switch for the Common Spanning Tree (CST) and for every interface in the tree.

Use the show spanning-tree interface command to display the spanning tree configuration for an interface within the Common Spanning Tree (CST).

Use the show spanning-tree mst instance_id command to display the spanning tree configuration for an instance within the Multiple Spanning Tree (MST).

For a description of the items displayed under "Spanning-tree information," see "Configuring Global Settings" on page 3-152. For a description of the items displayed for specific interfaces, see "Displaying Interface Settings" on page 3-156.

Example

```
Console#show spanning-tree
Spanning-tree information

 Spanning tree mode: MSTP
 Spanning tree enable/disable: enable
 Instance: 0
 Vlans configuration: 1-4094
 Priority: 32768
 Bridge Hello Time (sec.): 2
 Bridge Max Age (sec.): 20
 Bridge Forward Delay (sec.): 15
 Root Hello Time (sec.): 2
 Root Max Age (sec.): 20
 Root Forward Delay (sec.): 15
 Max hops: 20
 Remaining hops: 20
 Designated Root: 32768.0.0000ABCD0000
 Current root port: 1
 Current root cost: 10000
 Number of topology changes: 1
 Last topology changes time (sec.): 22
 Transmission limit: 3
 Path Cost Method: long

Eth 1/ 1 information
```

```
Admin status: enable
Role: root
State: forwarding
External admin path cost: 10000
Internal admin cost: 10000
External oper path cost: 10000
Internal oper path cost: 10000
Priority: 128
Designated cost: 200000
Designated port: 128.24
Designated root: 32768.0.0000ABCD0000
Designated bridge: 32768.0.0030F1552000
Fast forwarding: disable
Forward transitions: 1
Admin edge port: enable
Oper edge port: disable
Admin Link type: auto
Oper Link type: point-to-point
Spanning Tree Status: enable
```

show spanning-tree mst configuration

This command shows the configuration of the multiple spanning tree.

Command Mode

Privileged Exec

Example

```
Console#show spanning-tree mst configuration
Mstp Configuration Information

 Configuration name: R&D
 Revision level:0

 Instance Vlans
```

```
0 1,3-4094
1 2
Console#
```

5.21 VLAN Commands

A VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment. This section describes commands used to create VLAN groups, add port members, specify how VLAN tagging is used, and enable automatic VLAN registration for the selected interface.

Command Groups	Function
GVRP and Bridge Extension	Configures GVRP settings that permit automatic VLAN learning; shows the configuration for bridge extension MIB
Editing VLAN Groups	Sets up VLAN groups, including name, VID and state
Configuring VLAN Interfaces	Configures VLAN interface parameters, including ingress and egress tagging mode, ingress filtering, PVID, and GVRP
Displaying VLANInformation	Displays VLAN groups, status, port members, and MAC addresses
Configuring 802.1QTunneling	Configures IEEE 802.1Q tunneling (QinQ) to segregate and preserve customer VLAN IDs for traffic crossing the service provider network
Configuring Private VLANs	Configures private VLANs, including uplink and downlink ports
Configuring Protocol VLANs	Configures protocol-based VLANs based on frame type and protocol
Configuring Voice VLANs	Configures VoIP traffic detection and enables a Voice VLAN

Table 5-66 VLAN Command Groups

5.21.1 GVRP and Bridge Extension Commands

GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network. This section describes how to enable GVRP for individual interfaces and globally for the switch, as well as how to display default configuration settings for the Bridge Extension MIB.

Command	Function	Mode
bridge-ext gvrp	Enables GVRP globally for the switch	GC
show bridge-ext	Shows the global bridge extension configuration	PE
switchport gvrp	Enables GVRP for an interface	IC
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC
show gvrp configuration	Displays GVRP configuration for the selected interface	NE, PE
garp timer	Sets the GARP timer for the selected function	IC
show garp timer	Shows the GARP timer for the selected function	NE, PE

Table 5-67 GVRP and Bridge Extension Commands

bridge-ext gvrp

This command enables GVRP globally for the switch. Use the no form to disable it.

Syntax

[no] bridge-ext gvrp

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

GVRP defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network. This function should be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch.

Example

```
Console(config)#bridge-ext gvrp
Console(config)#
```

show bridge-ext

This command shows the configuration for bridge extension commands.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

See "Displaying Basic VLAN Information" on page 3-172 and "Displaying Bridge Extension Capabilities" on page 3-16 for a description of the displayed items.

Example

```
Console# show bridge-ext
  Max Support VLAN Numbers: 256
  Max Support VLAN ID: 4094
  Extended Multicast Filtering Services: No

  Static Entry Individual Port:      Yes
  VLAN Learning:                     IVL
  Configurable PVID Tagging:         Yes
  Local VLAN Capable:                No
  Traffic Classes:                   Enabled
```

```
Global GVRP Status:          Disabled
GMRP:                        Disabled
Console#
```

switchport gvrp

This command enables GVRP for a port. Use the no form to disable it.

Syntax

[no] switchport gvrp

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/6
Console(config-if)#switchport gvrp
Console(config-if)#
```

show gvrp configuration

This command shows if GVRP is enabled.

Syntax

show gvrp configuration [interface] interface

- ethernet unit/port -unit - Stack unit. (Range: 1) -port - Port number. (Range: 1-28)
- port-channel channel-id (Range: 1-12)

Default Setting

Shows both global and interface-specific configuration.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show gvrp configuration ethernet 1/6
Eth 1/ 6:
```

```
GVRP configuration: Enabled
Console#
```

garp timer

This command sets the values for the join, leave and leaveall timers. Use the no form to restore the timers' default values.

Syntax

garp timer {join | leave | leaveall} timer_value

no garp timer {join | leave | leaveall}

{join | leave | leaveall} - Which timer to set.

timer_value - Value of timer.

Ranges:

join: 20-1000 centiseconds

leave: 60-3000 centiseconds

leaveall: 500-18000 centiseconds

Default Setting

join: 20 centiseconds

leave: 60 centiseconds

leaveall: 1000 centiseconds

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Group Address Registration Protocol is used by GVRP and GMRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GMRP or GVRP registration/deregistration.

Timer values are applied to GVRP for all the ports on all VLANs.

Timer values must meet the following restrictions:

-leave >= (2 x join)

-leaveall > leave

Set GVRP timers on all Layer 2 devices connected in the same network to the same values. Otherwise, GVRP may not operate successfully.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#garp timer join 100
Console(config-if)#
```

Related Commands

show garp timer

show garp timer

This command shows the GARP timers for the selected interface.

Syntax

show garp timer [interface] interface

• ethernet unit/port -unit - Stack unit. (Range: 1) -port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

Shows all GARP timers.

Command Mode

Normal Exec, Privileged Exec VLAN Commands

Example

```
Console#show garp timer ethernet 1/1

Eth 1/ 1 GARP timer status:
  Join timer:    100 centiseconds
  Leave timer:    60 centiseconds
  Leaveall timer: 1000 centiseconds

Console#
```

Related Commands

garp timer

5.21.2 Editing VLAN Groups

Command	Function	Mode
vlan database	Enters VLAN database mode to add, change, and delete VLANs	GC
vlan	Configures a VLAN, including VID, name and state	VC

Table 5-68 Editing VLAN Groups

vlan database

This command enters VLAN database mode. All commands in this mode will take effect immediately.

Default Setting

None

Command Mode

Global Configuration

Command Usage

Use the VLAN database Command Mode to add, change, and delete VLANs. After finishing configuration changes, you can display the VLAN settings by entering the show vlan command.

Use the interface vlan Command Mode to define the port membership mode and add or remove ports from a VLAN. The results of these commands are written to the running-configuration file, and you can display this file by entering the show running-config command.

Example

```
Console(config)#vlan database
Console(config-vlan)#
```

Related Commands

show vlan

vlan

This command configures a VLAN. Use the no form to restore the Default Settings or delete a VLAN.

Syntax

vlan vlan-id [name vlan-name] media ethernet [state {active | suspend}]

no vlan vlan-id [name | state]

vlan-id -ID of configured VLAN. (Range: 1-4094, no leading zeroes)

name - Keyword to be followed by the VLAN name.

-vlan-name -ASCII string from 1 to 32 characters.

media ethernet - Ethernet media type.

state - Keyword to be followed by the VLAN state. -active -VLAN is operational. -suspend - VLAN is suspended.

Suspended VLANs do not pass packets.

Default Setting

By default only VLAN 1 exists and is active.

Command Mode

VLAN Database Configuration

Command Usage

no vlan vlan-id deletes the VLAN.

no vlan vlan-id name removes the VLAN name.

no vlan vlan-id state returns the VLAN to the default state (i.e., active).

You can configure up to 255 VLANs on the switch.

The switch allows 255 user-manageable VLANs. One other VLAN (VLAN ID 4093) is reserved for switch clustering.

Example

The following **Example** adds a VLAN, using VLAN ID 105 and name RD5. The VLAN is activated by default.

```
Console(config)#vlan database
Console(config-vlan)#vlan 105 name RD5 media ethernet
Console(config-vlan)#
```

Related Commands

show vlan

5.21.3 Configuring VLAN Interfaces

Command	Function	Mode
interface vlan	Enters interface configuration mode for a specified VLAN	GC
switchport mode	Configures VLAN membership mode for an interface	IC
switchport acceptable-frame-types	Configures frame types to be accepted by an interface	IC

switchport ingress-filtering	Enables ingress filtering on an interface	IC
switchport native vlan	Configures the PVID (native VLAN) of an interface	IC
switchport allowed vlan	Configures the VLANs associated with an interface	IC
switchport gvrp	Enables GVRP for an interface	IC
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC
switchport priority default	Sets a port priority for incoming untagged frames	IC

Table 5-69 Configuring VLAN Interfaces

interface vlan

This command enters interface configuration mode for VLANs, which is used to configure VLAN parameters for a physical interface.

Syntax

interface vlan vlan-id

vlan-id - ID of the configured VLAN. (Range: 1-4094, no leading zeroes)

Default Setting

None

Command Mode

Global Configuration

Example

The following **Example** shows how to set the interface configuration mode to VLAN 1, and then assign an IP address to the VLAN:

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.254 255.255.255.0
Console(config-if)#
```

Related Commands

shutdown

switchport mode

This command configures the VLAN membership mode for a port. Use the no form to restore the default.

Syntax

switchport mode {trunk | hybrid | private-vlan}

no switchport modehybrid -Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.

access - Specifies an access VLAN interface. The port transmits and receives untagged frames only.

trunk - Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. Note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are also transmitted as tagged frames.

private-vlan -For an explanation of this command see "switchport mode private-vlan" on page 4-240.

Default Setting

All ports are in hybrid mode with the PVID set to VLAN 1.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

The following shows how to set the configuration mode to port 1, and then set the switchport mode to hybrid:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport mode hybrid
Console(config-if)#
```

Related Commands

switchport acceptable-frame-types

switchport acceptable-frame-types

This command configures the acceptable frame types for a port. Use the no form to restore the default.

Syntax

switchport acceptable-frame-types {all | tagged no switchport acceptable-frame-types all - The port accepts all frames, tagged or untagged.

tagged - The port only receives tagged frames.

Default Setting

All frame types

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN.

Example

The following example shows how to restrict the traffic received on port 1 to tagged frames:

```
Console(config)#interface ethernet 1/1
```

```
Console(config-if)#switchport acceptable-frame-types tagged
Console(config-if)#
```

Related Commands

switchport mode

switchport ingress-filtering

This command enables ingress filtering for an interface.

Syntax

[no] switchport ingress-filtering

Although this command is available, the switch has ingress filtering permanently set to enabled. Therefore, trying to disable the filtering with the no switchport ingress-filtering command will produce this error message: "Note: Failed to ingress-filtering on ethernet interface !"

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Ingress filtering only affects tagged frames.

With ingress filtering enabled, a port will discard received frames tagged for VLANs for it which it is not a member.

Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STA. However, they do affect VLAN dependent BPDU frames, such as GMRP.

Example

The following example shows how to select port 1 and then enable ingress filtering:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport ingress-filtering
Console(config-if)#
```

switchport native vlan

This command configures the PVID (i.e., default VLAN ID) for a port. Use the no form to restore the default.

Syntax

switchport native vlan vlan-id no switchport native vlan vlan-id -Default VLAN ID for a port.

(Range: 1-4094, no leading zeroes)

Default Setting

VLAN 1

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Setting the native VLAN for a port can only be performed when the port is a member of the VLAN and the VLAN is untagged. The no switchport native vlan command will set the native VLAN of the port to untagged VLAN 1.

If acceptable frame types is set to all or switchport mode is set to hybrid, the PVID will be inserted into all untagged frames entering the ingress port.

Example

The following example shows how to set the PVID for port 1 to VLAN 3: .

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport native vlan 3
Console(config-if)#
```

switchport allowed vlan

This command configures VLAN groups on the selected interface. Use the no form to restore the default.

Syntax

switchport allowed vlan {add vlan-list [tagged | untagged] |remove vlan-list} no switchport allowed vlanadd vlan-list -List of VLAN identifiers to add.

remove vlan-list - List of VLAN identifiers to remove.

vlan-list - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. Do not enter leading zeros. (Range: 1-4094).

Default Setting

All ports are assigned to VLAN 1 by default.

The default frame type is untagged.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

A port, or a trunk with switchport mode set to hybrid, must be assigned to a VLAN as untagged.

If a trunk has switchport mode set to trunk (i.e., 1Q Trunk), then you can only assign an interface to VLAN groups as a tagged member.

Frames are always tagged within the switch. The tagged/untagged parameter used when adding a VLAN to an interface tells the switch whether to keep or remove the tag from a frame on egress.

If none of the intermediate network devices nor the host at the other end of the connection supports VLANs, the interface should be added to these VLANs as an untagged member. Otherwise, it is only necessary to add at most one VLAN as untagged, and this should correspond to the native VLAN for the interface.

If a VLAN on the forbidden list for an interface is manually added to that interface, the VLAN is automatically removed from the forbidden list for that interface.

Example

The following example shows how to add VLANs 1, 2, 5 and 6 to the allowed list as tagged VLANs for port 1:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 1,2,5,6 tagged
Console(config-if)#
```

switchport forbidden vlan

This command configures forbidden VLANs. Use the no form to remove the list of forbidden VLANs.

Syntax

switchport forbidden vlan {add vlan-list | remove vlan-list}

no switchport forbidden vlan

add vlan-list -List of VLAN identifiers to add.

remove vlan-list -List of VLAN identifiers to remove.

vlan-list - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. Do not enter leading zeros. (Range: 1-4094).

Default Setting

No VLANs are included in the forbidden list.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command prevents a VLAN from being automatically added to the specified interface via GVRP.

If a VLAN has been added to the set of allowed VLANs for an interface, then you cannot add it to the set of forbidden

VLANs for that same interface.

Example

The following example shows how to prevent port 1 from being added to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport forbidden vlan add 3
Console(config-if)#
```

5.21.4 Displaying VLAN Information

Command	Function	Mode
show vlan	Shows VLAN information	NE, PE
show interfaces status vlan	Displays status for the specified VLAN interface	NE, PE
show interfaces switchport	Displays the administrative and operational status of an interface	NE, PE

Table 5-70 Show VLAN Command

show vlan

This command shows VLAN information.

Syntax

show vlan [id vlan-id | name vlan-name]

id - Keyword to be followed by the VLAN ID. vlan-id - ID of the configured VLAN. (Range: 1-4094, no leading zeroes)

name - Keyword to be followed by the VLAN name.

vlan-name -ASCII string from 1 to 32 characters.

Default Setting

Shows all VLANs.

Command Mode

Normal Exec, Privileged Exec

Example

The following example shows how to display information for VLAN 1:

```
Console#show vlan id 1
Default VLAN ID : 1

 VLAN ID:            1
 Type:               Static
```

```
Name:                DefaultVlan
Status:              Active
Ports/Port Channels: Eth1/ 1(S) Eth1/ 2(S) Eth1/ 3(S) Eth1/ 4(S) Eth1/ 5(S)
                     Eth1/ 6(S) Eth1/ 7(S) Eth1/ 8(S) Eth1/ 9(S) Eth1/10(S)
                     Eth1/11(S) Eth1/12(S) Eth1/13(S) Eth1/14(S) Eth1/15(S)
                     Eth1/16(S) Eth1/17(S) Eth1/18(S) Eth1/19(S) Eth1/20(S)
                     Eth1/21(S) Eth1/22(S) Eth1/23(S) Eth1/24(S) Eth1/25(S)
                     Eth1/26(S) Eth1/27(S) Eth1/28(S)
Console#
```

5.21.5 Configuring IEEE 802.1Q Tunneling

IEEE 802.1Q tunneling (QinQ tunneling) uses a single Service Provider VLAN (SPVLAN) for customers who have multiple VLANs. Customer VLAN IDs are preserved and traffic from different customers is segregated within the service provider's network even when they use the same customer-specific VLAN IDs. QinQ tunneling expands VLAN space by using a VLAN-in-VLAN hierarchy, preserving the customer's original tagged packets, and adding SPVLAN tags to each frame (also called double tagging).

This section describes commands used to configure QinQ tunneling.

Command	Function	Mode
dot1q-tunnelsystem-tunnel-control	Configures the switch to operate in normal mode or QinQ mode	GC
switchport dot1q-tunnel mode	Configures an interface as a QinQ tunnel port	IC
switchport dot1q-tunnel tpid	Sets the Tag Protocol Identifier (TPID) value of a tunnel port	IC
show dot1q-tunnel	Displays the configuration of QinQ tunnel ports	PE
show interfaces switchport	Displays port QinQ operational status	PE

Table 5-71 IEEE 802.1Q Tunneling Commands

General Configuration Guidelines for QinQ

1. Configure the switch to QinQ mode (**dot1q-tunnel system-tunnel-control**).
2. Create a SPVLAN (**vlan**).
3. Configure the QinQ tunnel access port to dot1Q-tunnel access mode (**switchport dot1q-tunnel mode**).
4. Set the Tag Protocol Identifier (TPID) value of the tunnel access port. This step is required if the attached client is using a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (See **switchport dot1q-tunnel tpid**.)
5. Configure the QinQ tunnel access port to join the SPVLAN as an untagged member (**switchport allowed vlan**).
6. Configure the SPVLAN ID as the native VID on the QinQ tunnel access port (**switchport native vlan**).
7. Configure the QinQ tunnel uplink port to dot1Q-tunnel uplink mode (**switchport dot1q-tunnel mode**).
8. Configure the QinQ tunnel uplink port to join the SPVLAN as a tagged member (**switchport allowed vlan**).

Limitations for QinQ

- The native VLAN for the tunnel uplink ports and tunnel access ports cannot be the same. However, the same service VLANs can be set on both tunnel port types.
- IGMP Snooping should not be enabled on an tunnel access port.
- If the spanning tree protocol is enabled, be aware that a tunnel access or tunnel uplink port may be disabled if the spanning tree structure is automatically

reconfigured to overcome a break in the tree. It is therefore advisable to disable spanning tree on these ports.

dot1q-tunnel system-tunnel-control

This command sets the switch to operate in QinQ mode. Use the no form to disable QinQ operating mode.

Syntax

[no] dot1q-tunnel system-tunnel-control

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

QinQ tunnel mode must be enabled on the switch for QinQ interface settings to be functional.

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#
```

Related Commands

show dot1q-tunnel

show interfaces switchport

switchport dot1q-tunnel mode

This command configures an interface as a QinQ tunnel port. Use the no form to disable QinQ on the interface.

Syntax

switchport dot1q-tunnel mode {access | uplink}

no switchport dot1q-tunnel mode

access – Sets the port as an 802.1Q tunnel access port.

uplink – Sets the port as an 802.1Q tunnel uplink port.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- QinQ tunneling must be enabled on the switch using the **dot1q-tunnel system-tunnel-control** command before the **switchport dot1q-tunnel mode** interface command can take effect.
- When a tunnel uplink port receives a packet from a customer, the customer tag (regardless of whether there are one or

more tag layers) is retained in the inner tag, and the service provider's tag added to the outer tag.

- plink port receives a packet from the service provider, the outer service provider's tag is stripped off, and the packet passed onto the VLAN indicated by the inner tag. If no inner tag is found, the packet is passed onto the native VLAN defined for the uplink port.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#
```

Related Commands

show dot1q-tunnel

show interfaces switchport

switchport dot1q-tunnel tpid

This command sets the Tag Protocol Identifier (TPID) value of a tunnel uplink port. Use the no form to restore the Default Setting.

Syntax

switchport dot1q-tunnel tpid tpid no switchport dot1q-tunnel tpid

tpid – Sets the ethertype value for 802.1Q encapsulation. This identifier is used to select a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (Range: 0800-FFFF hexadecimal)

Default Setting

0x8100

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Use the **switchport dot1q-tunnel tpid** command to set a custom 802.1Q ethertype value on the selected interface. This feature allows the switch to interoperate with third-party switches that do not use the standard 0x8100 ethertype to identify 802.1Q-tagged frames. For example, if 0x1234 is set as the custom 802.1Q ethertype on a tunnel port, incoming frames containing that ethertype are assigned to the VLAN contained in the tag following the ethertype field, as they would be with a standard 802.1Q trunk. Frames arriving on the port containing any other ethertype are looked upon as untagged frames, and assigned to the native VLAN of that port.
- All port members of a VLAN should be set to the same ethertype.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel tpid 9100
Console(config-if)#
```

Related Commands

show interfaces switchport

show dot1q-tunnel

This command displays information about QinQ tunnel ports.

Command Mode

Privileged Exec

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#interface ethernet 1/2
Console(config-if)#switchport dot1q-tunnel mode uplink
Console(config-if)#end
Console#show dot1q-tunnel
```

Current double-tagged status of the system is Enabled

The dot1q-tunnel mode of the set interface 1/1 is Access mode, TPID is 0x8100.

The dot1q-tunnel mode of the set interface 1/2 is Uplink mode, TPID is 0x8100.

The dot1q-tunnel mode of the set interface 1/3 is Normal mode, TPID is 0x8100.

.

Related Commands

switchport dot1q-tunnel mode

5.21.6 Configuring Private VLANs

Private VLANs provide port-based security and isolation between ports within the assigned VLAN. This switch supports two types of private VLANs: primary/ secondary associated groups, and stand-alone isolated VLANs. A primary VLAN contains promiscuous ports that can communicate with all other ports in the private VLAN group, while a secondary (or community) VLAN contains community ports that can only communicate with other hosts within the secondary VLAN and with any of the promiscuous ports in the associated primary VLAN. Isolated VLANs, on the other hand, consist a single stand-alone VLAN that contains one promiscuous port and one or more isolated (or host) ports. In all cases, the promiscuous ports are designed to provide open access to an external network such as the Internet, while the community or isolated ports provide restricted access to local users.

Multiple primary VLANs can be configured on this switch, and multiple community VLANs can be associated with each primary VLAN. One or more isolated VLANs can also be configured. (Note that private VLANs and normal VLANs can exist simultaneously within the same switch.)

This section describes commands used to configure private VLANs.

Command	Function	Mode
Edit Private VLAN Groups		
private-vlan	Adds or deletes primary, community, or isolated VLANs	VC
private-vlan association	Associates a community VLAN with a primary VLAN	VC
Configure Private VLAN Interfaces		
switchport modeprivate-vlan	Sets an interface to host mode or promiscuous mode	IC
switchport private-vlan host-association	Associates an interface with a secondary VLAN	IC
switchport private-vlan isolated	Associates an interface with an isolated VLAN	IC
switchport private-vlan mapping	Maps an interface to a primary VLAN	IC
Display Private VLAN Information		
show private-vlan	Shows private VLAN information	NE, PE

Table 5-72 Private VLAN Commands

To configure primary/secondary associated groups, follow these steps:

1. Use the **private-vlan** command to designate one or more community VLANs and the primary VLAN that will channel traffic outside of the community groups.
2. Use the **private-vlan association** command to map the community VLAN(s) to the primary VLAN.
3. Use the **switchport mode private-vlan** command to configure ports as promiscuous (i.e., having access to all ports in the primary VLAN) or host (i.e., community port).
4. Use the **switchport private-vlan host-association** command to assign a port to a secondary VLAN.
5. Use the **switchport private-vlan mapping** command to assign a port to a primary VLAN.
6. Use the **show private-vlan** command to verify your configuration settings.

To configure isolated VLANs, follow these steps:

1. Use the **private-vlan** command to designate an isolated VLAN that will contain a single promiscuous port and one or more isolated ports.
2. Use the **switchport mode private-vlan** command to configure one port as promiscuous (i.e., having access to all ports in the isolated VLAN) one or more ports as host (i.e., isolated port).
3. Use the switchport private-vlan isolated command to assign a port to an isolated VLAN.
4. Use the show private-vlan command to verify your configuration settings.

private-vlan

Use this command to create a primary, community, or isolated private VLAN. Use the no form to remove the specified private VLAN.

Syntax

private-vlan vlan-id {community | primary | isolated}

no private-vlan vlan-id vlan-id -ID of private VLAN.

- (Range: 1-4094, no leading zeroes).
- community - A VLAN in which traffic is restricted to host members in the same VLAN and to promiscuous ports in the associate primary VLAN.
- primary - A VLAN which can contain one or more community VLANs, and serves to channel traffic between community VLANs and other locations.
- isolated – Specifies an isolated VLAN. Ports assigned to an isolated VLAN can only communicate with the promiscuous port within their own VLAN.

Default Setting

None

Command Mode

VLAN Configuration

Command Usage

- Private VLANs are used to restrict traffic to ports within the same community or isolated VLAN, and channel traffic passing outside the community through promiscuous ports. When using community VLANs, they must be mapped to an associated "primary" VLAN that contains promiscuous ports. When using an isolated VLAN, it must be configured to contain a single promiscuous port.
- Port membership for private VLANs is static. Once a port has been assigned to a private VLAN, it cannot be dynamically moved to another VLAN via GVRP.
- Private VLAN ports cannot be set to trunked mode. (See "switchport mode" on page 4-228.)

Example

```
Console(config)#vlan database
Console(config-vlan)#private-vlan 2 primary
Console(config-vlan)#private-vlan 3 community
Console(config)#
```

private vlan association

Use this command to associate a primary VLAN with a secondary (i.e., community) VLAN. Use the no form to remove all associations for the specified primary VLAN.

Syntax

private-vlan primary-vlan-id association {secondary-vlan-id | add secondary-vlan-id | remove secondary-vlan-id} no private-vlan primary-vlan-id association

primary-vlan-id -ID of primary VLAN.

(Range: 1-4094, no leading zeroes).

secondary-vlan-id -ID of secondary (i.e, community) VLAN. (Range: 1-4094, no leading zeroes).

Default Setting

None

Command Mode

VLAN Configuration

Command Usage

Secondary VLANs provide security for group members. The associated primary VLAN provides a common interface for access to other network resources within the primary VLAN (e.g., servers configured with promiscuous ports) and to resources outside of the primary VLAN (via promiscuous ports).

Example

```
Console(config-vlan)#private-vlan 2 association 3
Console(config)#
```

switchport mode private-vlan

Use this command to set the private VLAN mode for an interface. Use the no form to restore the Default Setting.

Syntax

switchport mode private-vlan {host | promiscuous}

no switchport mode private-vlan host – This port type can subsequently be assigned to a community or isolated VLAN.

promiscuous – This port type can communicate with all other promiscuous ports in the same primary VLAN, as well as with all the ports in the associated secondary VLANs.

Default Setting

Normal VLAN

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

To assign a promiscuous port to a primary VLAN, use the switchport private-vlan mapping command. To assign a host port to a community VLAN, use the private-vlan host association command.

To assign a promiscuous port or host port to an isolated VLAN, use the switchport private-vlan isolated command.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport mode private-vlan promiscuous
Console(config-if)#exit
Console(config)#interface ethernet 1/3
Console(config-if)#switchport mode private-vlan host
Console(config-if)#
```

switchport private-vlan host-association

Use this command to associate an interface with a secondary VLAN. Use the no form to remove this association.

Syntax

switchport private-vlan host-association secondary-vlan-id no switchport private-vlan host-association secondary-vlan-id - ID of secondary (i.e., community) VLAN.

(Range: 1-4094, no leading zeroes).

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

All ports assigned to a secondary (i.e., community) VLAN can pass traffic between group members, but must communicate with resources outside of the group via promiscuous ports in the associated primary VLAN.

Example

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport private-vlan host-association 3
Console(config-if)#
```

switchport private-vlan isolated

Use this command to assign an interface to an isolated VLAN. Use the no form to remove this assignment.

Syntax

switchport private-vlan isolated isolated-vlan-id no switchport private-vlan isolated isolated-vlan-id - ID of isolated VLAN. (Range: 1-4094).

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Host ports assigned to a isolated VLAN cannot pass traffic between group members, and must communicate with resources outside of the group via a promiscuous port.

Example

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport private-vlan isolated 3
Console(config-if)#
```

switchport private-vlan mapping

Use this command to map an interface to a primary VLAN. Use the no form to remove this mapping.

Syntax

switchport private-vlan mapping primary-vlan-id

no switchport private-vlan mapping

primary-vlan-id – ID of primary VLAN. (Range: 1-4094, no leading zeroes).

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Promiscuous ports assigned to a primary VLAN can communicate with any other promiscuous ports in the same VLAN, and with the group members within any associated secondary VLANs.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport private-vlan mapping 2
Console(config-if)#
```

show private-vlan

Use this command to show the private VLAN configuration settings on this switch.

Syntax

show private-vlan [community | isolated | primary] community – Displays all community VLANs, along with their associated primary VLAN and assigned host interfaces.

isolated – Displays an isolated VLAN, along with the assigned promiscuous interface and host interfaces. The Primary and Secondary fields both display the isolated VLAN ID.

primary – Displays all primary VLANs, along with any assigned promiscuous interfaces.

Default Setting

None

Command Mode

Privileged Executive

Example

```
Console#show private-vlan
Primary Secondary    Type    Interfaces

5                    primary    Eth1/ 3
 5 6 community    Eth1/ 4 Eth1/ 5
 0 8 isolated

Console#
```

5.21.7 Configuring Protocol-based VLANs

The network devices required to support multiple protocols cannot be easily grouped into a common VLAN. This may require non-standard devices to pass traffic between different VLANs in order to encompass all the devices participating in a specific protocol. This kind of configuration deprives users of the basic benefits of VLANs, including security and easy accessibility.

To avoid these problems, you can configure this switch with protocol-based VLANs that divide the physical network into logical VLAN groups for each required protocol. When a frame is received at a port, its VLAN membership can then be determined based on the protocol type in use by the inbound packets.

Command	Function	Mode
protocol-vlan protocol-group	Create a protocol group, specifying the supported protocols	GC
protocol-vlan protocol-group	Maps a protocol group to a VLAN	IC
show protocol-vlan protocol-group	Shows the configuration of protocol groups	PE
show interfaces protocol-group	Shows the mapping of protocol groups to VLAN	PE

Table 5-73 Protocol-based VLAN Commands

To configure protocol-based VLANs, follow these steps:

1. First configure VLAN groups for the protocols you want to use (page 4-226). Although not mandatory, we suggest configuring a separate VLAN for each major protocol running on your network. Do not add port members at this time.
2. Create a protocol group for each of the protocols you want to assign to a VLAN using the protocol-vlan protocol-group command (General Configuration mode).
3. Then map the protocol for each interface to the appropriate VLAN using the protocol-vlan protocol-group command (Interface Configuration mode).

protocol-vlan protocol-group (Configuring Groups)

This command creates a protocol group, or adds specific protocols to a group. Use the no form to remove a protocol group.

Syntax

protocol-vlan protocol-group group-id [{**add** | **remove**} **protocol-type** {apple_talk | ip | ipx | 0-ffff **frame-type** frame}]

no protocol-vlan protocol-group group-id

- group-id - Group identifier of this protocol group. (Range: 1-2147483647)
- frame - Frame type used by this protocol. (Options: ethernet, llc-other, rfc-1042, snap_8021h). The frame type must be specified if you manually define the protocol type with its hexadecimal code instead of choosing the preconfigured protocol types of apple_talk, ip or ipx. The three preconfigured protocol types match all frame-types.

Default Setting

No protocol groups are configured.

Command Mode

Global Configuration

Example

The following creates protocol group 1, and specifies the IPX protocol type. Protocol VLAN group 2 is created with protocol-type IPv6 (86DD) and frame-type ethernet specified:

```
Console(config)#protocol-vlan protocol-group 1 add protocol-type ipx
Console(config)#protocol-vlan protocol-group 2 add protocol-type 86dd
frame-type ethernet
Console(config)#
```

protocol-vlan protocol-group (Configuring Interfaces)

This command maps a protocol group to a VLAN for the current interface. Use the **no** form to remove the protocol mapping for this interface.

Syntax

protocol-vlan protocol-group group-id **vlan** vlan-id

no protocol-vlan protocol-group group-id **vlan**

- group-id - Group identifier of this protocol group. (Range: 1-2147483647)
- vlan-id -VLAN to which matching protocol traffic is forwarded. (Range: 1-4094)

Default Setting

No protocol groups are mapped for any interface.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When creating a protocol-based VLAN, only assign interfaces via this command. If you assign interfaces using any of the other VLAN commands (such as the vlan command on page 4-226), these interfaces will admit traffic of any protocol type into the associated VLAN.
- A maximum of 20 protocol VLAN groups can be defined on the switch. A maximum of 5 protocol VLAN groups can be mapped to any interface.
- When a frame enters a port that has been assigned to a protocol VLAN, it is processed in the following manner:
  -If the frame is tagged, it will be processed according to the standard rules applied to tagged frames.
  -If the frame is untagged and the protocol type matches, the frame is forwarded to the appropriate VLAN.
  -If the frame is untagged but the protocol type does not match, the frame is forwarded to the default VLAN for this interface.

Example

The following example maps the traffic entering Port 1 which matches the protocol type specified in protocol group 1 to VLAN 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#protocol-vlan protocol-group 1 vlan 2
Console(config-if)#
```

show protocol-vlan protocol-group

This command shows the frame and protocol type associated with protocol groups.

Syntax

s**how protocol-vlan protocol-group** [group-id]

group-id - Group identifier for a protocol group. (Range: 1-2147483647)

Default Setting

All protocol groups are displayed.

Command Mode

Privileged Exec

Example

This example shows many protocol groups configured for various protocol-types and frame-types:

```
Console# show protocol-vlan protocol-group
ProtocolGroup ID      Frame Type    Protocol Type
----------------------------- -------------------      -----------
                4     Ethernet          0B AD
                8     Ethernet          80 2E
             5000     Ethernet          81 37
               12     Ethernet          81 46
             5000     Ethernet          86 DD
                6     RFC 1042          43 21
               10     RFC 1042          80 49
                7     SNAP 802.1h       80 3C
               11     SNAP 802.1h       80 A3
               50     SNAP 802.1h       81 2B
             5000     SNAP 802.1h       86 DD
                1                       08 00
                3                       80 9B
                2                       81 37
Console#
```

show interfaces protocol-group

This command shows the mapping from protocol groups to VLANs for the selected interfaces.

Syntax

show interfaces protocol-vlan protocol-group [interface]

interface

- **ethernet** unit/port

  -unit - Stack unit. (Range: 1)

  -port - Port number. (Range: 1-26)

- **port-channel** channel-id (Range: 1-12)

Default Setting

The mapping for all interfaces is displayed.

Command Mode

Privileged Exec

Example

This shows that traffic entering Port 1 that matches the specifications for protocol group 1 will be mapped to VLAN 2:

```
Console# show interfaces protocol-vlan protocol-group
    Port    ProtocolGroup ID    Vlan ID
    Eth 1/1                  1 vlan2


Console#
```

5.21.8 Configuring Voice VLANs

The switch allows you to specify a Voice VLAN for the network and set a CoS priority for the VoIP traffic. VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member to the Voice VLAN. Alternatively, switch ports can be manually configured.

Command	Function	Mode
voice vlan	Defines the Voice VLAN ID	GC
voice vlan aging	Configures the aging time for Voice VLAN ports	GC
voice vlan mac-address	Configures VoIP device MAC adresses	GC
switchport voice vlan	Sets the Voice VLAN port mode	IC
switchport voice vlan rule	Sets the automatic VoIP traffic detection method for ports	IC
switchport voice vlan security	Enables Voice VLAN security on ports	IC
switchport voice vlan priority	Sets the VoIP traffic priority for ports	IC
show voice vlan	Displays Voice VLAN settings	PE

Table 5-74 Voice VLAN Commands

voice vlan

This command enables VoIP traffic detection and defines the Voice VLAN ID. Use the no form to disable the Voice VLAN.

Syntax

voice vlan voice-vlan-id

no voice vlan

voice-vlan-id - Specifies the voice VLAN ID. (Range: 1-4094)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When IP telephony is deployed in an enterprise network, it is recommended to isolate the Voice over IP (VoIP) network traffic from other data traffic. Traffic isolation can provide higher voice quality by preventing excessive packet delays, packet loss, and jitter. This is best achieved by assigning all VoIP traffic to a single Voice VLAN.
- VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member of the Voice VLAN.
- Only one Voice VLAN is supported and it must already be created on the switch before it can be specified as the Voice VLAN.
- The Voice VLAN ID cannot be modified when global auto-detection status is enabled (see the **switchport voice vlan**

command).

Example

The following example enables VoIP traffic detection and specifies the Voice VLAN ID as 1234.

```
Console(config)#voice vlan 1234
Console(config)#
```

voice vlan aging

This command sets the Voice VLAN membership time out. Use the no form to restore the default.

Syntax

voice vlan aging minutes

no voice vlan

minutes - Specifies the port Voice VLAN membership time out.

(Range: 5-43200 minutes)

Default Setting

1440 minutes

Command Mode

Global Configuration

Command Usage

The Voice VLAN aging time is the time after which a port is removed from the Voice VLAN when VoIP traffic is no longer received on that port.

Example

The following example configures the Voice VLAN aging time as 3000 minutes.

```
Console(config)#voice vlan aging 3000
Console(config)#
```

voice vlan mac-address

This command specifies MAC address ranges to add to the OUI Telephony list. Use the no form to remove an entry from the list.

Syntax

voice vlan mac-address mac-address **mask** address-mask [description description]

no voice vlan mac-address mac-address **mask** address-mask

- mac-address - Defines a MAC address OUI that identifies VoIP devices in the network.
- (For **Example**,01-23-45-00-00-00)

- address-mask - Identifies a range of MAC addresses.
  (Range: 80-00-00-00-00-00 to FF-FF-FF-FF-FF-FF)
- description - User-defined text that identifies the VoIP devices. (Range: 1-32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- VoIP devices attached to the switch can be identified by the manufacturer's Organizational Unique Identifier (OUI) in the source MAC address of received packets. OUI numbers are assigned to manufacturers and form the first three octets of device MAC addresses. The MAC OUI numbers for VoIP equipment can be configured on the switch so that traffic from these devices is recognized as VoIP.
- Selecting a mask of FF-FF-FF-00-00-00 identifies all devices with the same OUI (the first three octets). Other masks restrict the MAC address range. Selecting FF-FF-FF-FF-FF-FF specifies a single MAC address.

Example

The following example adds a MAC OUI to the OUI Telephony list.

```
Console(config)#voice vlan mac-address 00-12-34-56-78-90 mask
ff-ff-ff-00-00-00 description A new phone
Console(config)#
```

switchport voice vlan

This command specifies the Voice VLAN mode for ports. Use the no form to disable the Voice VLAN feature on the port.

Syntax

switchport voice vlan {manual | auto}

no switchport voice vlan

- **manual** - The Voice VLAN feature is enabled on the port, but the port must be manually added to the Voice VLAN.
- **auto** - The port will be added as a tagged member to the Voice VLAN when VoIP traffic is detected on the port.

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

When **auto** is selected, you must select the method to use for detecting VoIP traffic, either OUI or 802.1ab (LLDP) using

the **switchport voice vlan** command (page 4-251). When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list.

Example

The following example sets port 1 to Voice VLAN auto mode.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan auto
Console(config-if)#
```

switchport voice vlan rule

This command selects a method for detecting VoIP traffic on a port. Use the **no** form to disable the selected detection method on a port.

Syntax

[no] switchport voice vlan rule {oui | lldp}

- **oui** - Traffic from VoIP devices is detected by the Organizationally Unique Identifier (OUI) of the source MAC address.
- **lldp** - Uses LLDP to discover VoIP devices attached to the port.

Default Setting

OUI: Enabled

LLDP: Disabled

Command Mode

Interface Configuration

Command Usage

- When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list (see the **voice vlan mac-address** command). MAC address OUI numbers must be configured in the Telephony OUI list so that the switch recognizes the traffic as being from a VoIP device.
- LLDP checks that the "telephone bit" in the system capability TLV is turned on. See "**LLDP Commands**" for more information on LLDP.

Example

The following example enables the OUI method on port 1 for detecting VoIP traffic.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan rule oui
Console(config-if)#
```

switchport voice vlan security

This command enables security filtering for VoIP traffic on a port. Use the no form to disable filtering on a port.

Syntax

[no] switchport voice vlan security

4-251

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

- Security filtering discards any non-VoIP packets received on a port that are tagged with the voice VLAN ID. VoIP traffic is identified by source MAC addresses configured in the Telephony OUI list, or through LLDP that discovers VoIP devices attached to the switch. Packets received from non-VoIP sources are dropped.
- When enabled, be sure the MAC address ranges for VoIP devices are configured in the Telephony OUI list (**voice vlan mac-address**).

Example

The following example enables security filtering on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan security
Console(config-if)#
```

switchport voice vlan priority

This command specifies a CoS priority for VoIP traffic on a port. Use the no form to restore the default priority on a port.

Syntax

switchport voice vlan priority priority-value

no switchport voice vlan priority

priority-value -The CoS priority value. (Range: 0-6)

Default Setting

6

Command Mode

Interface Configuration

Command Usage

Specifies a CoS priority to apply to a port's VoIP traffic on the Voice VLAN. The priority of any received VoIP packet is overwritten with the new priority when the Voice VLAN feature is active for a port.

Example

The following example sets the CoS priority to 5 on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan priority 5
Console(config-if)#
```

show voice vlan

This command displays the Voice VLAN settings on the switch and the OUI Telephony list.

Syntax

show voice vlan {oui | status}

• **oui** - Displays the OUI Telephony list.

• **status** -Displays the global and port Voice VLAN settings.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show voice vlan status
Global Voice VLAN Status
Voice VLAN Status : Enabled
Voice VLAN ID : 1234
Voice VLAN aging time : 1440 minutes

Voice VLAN Port Summary
Port        Mode              Security          Rule       Priority
----------------------------  ----------------  ---------- ----------
 Eth 1/ 1 Auto              Enabled          OUI       6
 Eth 1/ 2 Disabled          Disabled         OUI       6
 Eth 1/ 3 Manual            Enabled          OUI       5
 Eth 1/ 4 Auto              Enabled          OUI       6
 Eth 1/ 5 Disabled          Disabled         OUI       6
 Eth 1/ 6 Disabled          Disabled         OUI       6
 Eth 1/ 7 Disabled          Disabled         OUI       6
 Eth 1/ 8 Disabled          Disabled         OUI       6
 Eth 1/ 9 Disabled          Disabled         OUI       6
 Eth 1/10 Disabled          Disabled         OUI       6

Console# show voice vlan oui
 OUIAddress          Mask                 Description
 00-12-34-56-78-9A   FF-FF-FF-00-00-00    old phones
 00-11-22-33-44-55   FF-FF-FF-00-00-00    new phones
```

```
  00-98-76-54-32-10          FF-FF-FF-FF-FF-FF      Marc' phone

Console#
```

5.22 LLDP Commands

Link Layer Discovery Protocol (LLDP) is used to discover basic information about neighboring devices on the local broadcast domain. LLDP is a Layer 2 protocol that uses periodic broadcasts to advertise information about the sending device. Advertised information is represented in **Type Length Value (TLV)** format according to the IEEE 802.1ab standard, and can include details such as device identification, capabilities and configuration settings. LLDP also defines how to store and maintain information gathered about the neighboring network nodes it discovers.

Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

Command	Function	Mode
lldp	Enables LLDP globally on the switch	GC
lldp holdtime-multiplier	Configures the time-to-live (TTL) value sent in LLDP advertisements	GC
medFastStartCount	Configures how many medFastStart packets are transmitted	GC
lldp notification-interval	Configures the allowed interval for sending SNMPnotifications about LLDP changes	GC
lldp refresh-interval	Configures the periodic transmit interval for LLDP advertisements	GC
lldp reinit-delay	Configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down	GC
lldp tx-delay	Configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables	GC
lldp admin-status	Enables LLDP transmit, receive, or transmit and receive mode on the specified port	IC
lldp notification	Enables the transmission of SNMP trap notifications about LLDP changes	IC
lldp mednotification	Enables the transmission of SNMP trap notifications about LLDP-MED changes	IC

lldp basic-tlv management-ip-address	Configures an LLDP-enabled port to advertise themanagement address for this device	IC
lldp basic-tlv port-description	Configures an LLDP-enabled port to advertise its port description	IC
lldp basic-tlv system-capabilities	Configures an LLDP-enabled port to advertise its system capabilities	IC
lldp basic-tlv system-description	Configures an LLDP-enabled port to advertise the system description	IC
lldp basic-tlv system-name	Configures an LLDP-enabled port to advertise its system name	IC
lldp dot1-tlv proto-ident*	Configures an LLDP-enabled port to advertise the supported protocols	IC
lldp dot1-tlv proto-vid*	Configures an LLDP-enabled port to advertise port related VLAN information	IC
lldp dot1-tlv pvid*	Configures an LLDP-enabled port to advertise its default VLAN ID	IC
lldp dot1-tlv vlan-name*	Configures an LLDP-enabled port to advertise its VLAN name	IC
lldp dot3-tlv link-agg	Configures an LLDP-enabled port to advertise its link aggregation capabilities	IC
lldp dot3-tlv mac-phy	Configures an LLDP-enabled port to advertise its MAC and physical layer specifications	IC
lldp dot3-tlv max-frame	Configures an LLDP-enabled port to advertise its maximum frame size	IC
lldp dot3-tlv poe	Configures an LLDP-enabled port to advertise its Power-over-Ethernet capabilities	IC
lldp medtlv extpoe	Configures an LLDP-MED-enabled port to advertise its extended Pover over Ethernet configuration and usage information	IC
lldp medtlv inventory	Configures an LLDP-MED-enabled port to advertise its inventory identification details	IC
lldp medtlv location	Configures an LLDP-MED-enabled port to advertise its location identification details	IC
lldp medtlv med-cap	Configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities	IC
lldp medtlv network-policy	Configures an LLDP-MED-enabled port to advertise its network policy configuration	IC
show lldp config	Shows LLDP configuration settings for all ports	PE
show lldp info local-device	Shows LLDP global and interface-specific configuration settings for this device	PE
show lldp inforemote-device	Shows LLDP global and interface-specific configuration settings	PE

	for remote devices	
show lldp info statistics	Shows statistical counters for all LLDP-enabled interfaces	PE
* Vendor-specific options may or may not be advertised by neighboring devices.		

Table 5-75 LLDP Commands

lldp

This command enables LLDP globally on the switch. Use the no form to disable LLDP.

Syntax

[no] lldp

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#lldp
Console(config)#
```

lldp holdtime-multiplier

This command configures the time-to-live (TTL) value sent in LLDP advertisements. Use the no form to restore the Default Setting.

Syntax

lldp holdtime-multiplier value

no lldp holdtime-multiplier

value - Calculates the TTL in seconds based on

(holdtime-multiplier * refresh-interval) ≤ 65536

(Range: 2 - 10)

Default Setting

Holdtime multiplier: 4

TTL: 4*30 = 120 seconds

Command Mode

Global Configuration

Command Usage

The time-to-live tells the receiving LLDP agent how long to retain all information pertaining to the sending LLDP agent if it does not transmit updates in a timely manner.

Example

```
Console(config)#lldp holdtime-multiplier 10
Console(config)#
```

lldp medFastStartCount

This command specifies the amount of MED Fast Start LLDPDUs to transmit during the activation process of the LLDP-MED Fast Start mechanism.

Syntax

lldp medfaststartcount packets seconds - Amount of packets. (Range: 1-10 packets; Default: 4 packets)

Default Setting

4 packets

Command Mode

Global Configuration

Command Usage

The MEDFastStartCount parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

Example

```
Console(config)#lldp medfaststartcount 6
Console(config)#
```

lldp notification-interval

This command configures the allowed interval for sending SNMP notifications about LLDP MIB changes. Use the no form to restore the Default Setting.

Syntax

lldp notification-interval seconds

no lldp notification-interval seconds - Specifies the periodic interval at which SNMP notifications are sent.

(Range: 5 - 3600 seconds)

Default Setting

5 seconds

Command Mode

Global Configuration

Command Usage

This parameter only applies to SNMP applications which use data stored in the LLDP MIB for network monitoring or

management.

Information about changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example

```
Console(config)#lldp notification-interval 30
Console(config)#
```

lldp refresh-interval

This command configures the periodic transmit interval for LLDP advertisements. Use the no form to restore the Default Setting.

Syntax

lldp refresh-interval seconds

no lldp refresh-delay

seconds - Specifies the periodic interval at which LLDP advertisements are sent. (Range: 5 - 32768 seconds)

Default Setting

30 seconds

Command Mode

Global Configuration

Command Usage

This attribute must comply with the following rule:

(refresh-interval * holdtime-multiplier) ≤ 65536

Example

```
Console(config)#lldp refresh-interval 60
Console(config)#
```

lldp reinit-delay

This command configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down. Use the no form to restore the Default Setting.

Syntax

lldp reinit-delay seconds

no lldp reinit-delay

seconds - Specifies the delay before attempting to re-initialize LLDP. (Range: 1 - 10 seconds)

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

When LLDP is re-initialized on a port, all information in the remote systems LLDP MIB associated with this port is deleted.

Example

```
Console(config)#lldp reinit-delay 10
Console(config)#
```

lldp tx-delay

This command configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables. Use the no form to restore the Default Setting.

Syntax

lldp tx-delay seconds

no lldp tx-delay

seconds - Specifies the transmit delay. (Range: 1 - 8192 seconds)

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

The transmit delay is used to prevent a series of successive LLDP transmissions during a short period of rapid changes in local LLDP MIB objects, and to increase the probability that multiple, rather than single changes, are reported in each transmission.

This attribute must comply with the following rule:

(4 * tx-delay) ≤refresh-interval

Example

```
Console(config)#lldp tx-delay 10
Console(config)#
```

lldp admin-status

This command enables LLDP transmit, receive, or transmit and receive mode on the specified port. Use the no form to disable this feature.

Syntax

lldp admin-status {rx-only | tx-only | tx-rx}

no lldp admin-status

rx-only - Only receive LLDP PDUs.

tx-only - Only transmit LLDP PDUs.

tx-rx -Both transmit and receive LLDP Protocol Data Units (PDUs).

Default Setting

tx-rx

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp admin-status rx-only
Console(config-if)#
```

lldp notification

This command enables the transmission of SNMP trap notifications about LLDP changes.

Use the no form to disable LLDP notifications.

Syntax

[no] lldp notification

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This option sends out SNMP trap notifications to designated target stations at the interval specified by the lldp notification-interval command (page 4-257). Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), or organization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.
- SNMP trap destinations are defined using the snmp-server host command (page 4-72).
- Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should

therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp notification
Console(config-if)#
```

lldp mednotification

This command enables the transmission of SNMP trap notifications about LLDP-MED changes. Use the no form to disable LLDP-MED notifications.

Syntax

[no] lldp mednotification

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This option sends out SNMP trap notifications to designated target stations at the interval specified by the lldp notification-interval command. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA 1057), or oganization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.
- SNMP trap destinations are defined using the snmp-server host command.
- Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp mednotification
Console(config-if)#
```

lldp basic-tlv management-ip-address

This command configures an LLDP-enabled port to advertise the management address for this device. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv management-ip-address

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.
- The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications to perform network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity MIB.
- Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV.
- Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv management-ip-address
Console(config-if)#
```

lldp basic-tlv port-description

This command configures an LLDP-enabled port to advertise its port description. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv port-description

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv port-description
Console(config-if)#
```

lldp basic-tlv system-capabilities

This command configures an LLDP-enabled port to advertise its system capabilities. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv system-capabilities

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-capabilities
Console(config-if)#
```

lldp basic-tlv system-description

This command configures an LLDP-enabled port to advertise the system description. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv system-description

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-description
Console(config-if)#
```

lldp basic-tlv system-name

This command configures an LLDP-enabled port to advertise the system name. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv system-name

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name, and is in turn based on the hostname command (page 4-16).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-name
Console(config-if)#
```

lldp dot1-tlv proto-ident

This command configures an LLDP-enabled port to advertise the supported protocols. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv proto-ident

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the protocols that are accessible through this interface.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv proto-ident
Console(config-if)#
```

lldp dot1-tlv proto-vid

This command configures an LLDP-enabled port to advertise port related VLAN information. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv proto-vid

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the port-based and protocol-based VLANs configured on this interface (see "Configuring VLAN Interfaces" on page 4-227 and "Configuring Protocol-based VLANs" on page 4-244).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv proto-vid
Console(config-if)#
```

lldp dot1-tlv pvid

This command configures an LLDP-enabled port to advertise its default VLAN ID. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv pvid

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The port's default VLAN identifier (PVID) indicates the VLAN with which untagged or priority-tagged frames are associated (see switchport native vlan on page 4-230).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv pvid
Console(config-if)#
```

lldp dot1-tlv vlan-name

This command configures an LLDP-enabled port to advertise its VLAN name. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv vlan-name

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the name of all VLANs to which this interface has been assigned. See switchport allowed vlan on page 4-231 and protocol-vlan protocol-group (Configuring Interfaces) on page 4-245.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv vlan-name
Console(config-if)#
```

lldp dot3-tlv link-agg

This command configures an LLDP-enabled port to advertise link aggregation capabilities. Use the no form to disable this feature.

Syntax

[no] lldp dot3-tlv link-agg

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises link aggregation capabilities, aggregation status of the link, and the 802.3 aggregated port identifier

if this interface is currently a link aggregation member.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot3-tlv link-agg
Console(config-if)#
```

lldp dot3-tlv mac-phy

This command configures an LLDP-enabled port to advertise its MAC and physical layer capabilities. Use the no form to disable this feature.

Syntax

[no] lldp dot3-tlv mac-phy

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises MAC/PHY configuration/status which includes information about auto-negotiation capabilities, port speed, and duplex mode.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot3-tlv mac-phy
Console(config-if)#
```

lldp dot3-tlv max-frame

This command configures an LLDP-enabled port to advertise its maximum frame size. Use the no form to disable this feature.

Syntax

[no] lldp dot3-tlv max-frame

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Refer to "Frame Size Commands" on page 4-32 for information on configuring the maximum frame size for this switch.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot3-tlv max-frame
Console(config-if)#
```

lldp dot3-tlv poe

This command configures an LLDP-enabled port to advertise its Power-over-Ethernet (PoE) capabilities. Use the no form to disable this feature.

Syntax

[no] lldp dot3-tlv poe

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises Power-over-Ethernet capabilities, including whether or not PoE is supported, currently enabled, if the port pins through which power is delivered can be controlled, the port pins selected to deliver power, and the power class. Note that this device does not support PoE capabilities.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot3-tlv poe
Console(config-if)#
```

lldp medtlv extpoe

This command configures an LLDP-MED-enabled port to advertise and accept Extended Power-over-Ethernet configuration and usage information. Use the no form to disable this feature.

Syntax

[no] lldp medtlv extpoe

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises extended Power-over-Ethernet capability details, such as power availability from the switch, and power state of the switch, including whether the switch is operating from primary or backup power (the Endpoint Device could use this information to decide to enter power conservation mode). Note that this device does not support PoE capabilities.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp medtlv extpoe
Console(config-if)#
```

lldp medtlv inventory

This command configures an LLDP-MED-enabled port to advertise its inventory identification details. Use the no form to disable this feature.

Syntax

[no] lldp medtlv inventory

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp medtlv inventory
Console(config-if)#
```

lldp medtlv location

This command configures an LLDP-MED-enabled port to advertise its location identification details. Use the no form to disable

this feature.

Syntax

[no] lldp medtlv location

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises location identification details.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp medtlv location
Console(config-if)#
```

lldp medtlv med-cap

This command configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities. Use the no form to disable this feature.

Syntax

[no] lldp medtlv med-cap

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp medtlv med-cap
Console(config-if)#
```

lldp medtlv network-policy

This command configures an LLDP-MED-enabled port to advertise its network policy configuration. Use the no form to disable this feature.

Syntax

[no] lldp medtlv network-policy

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper network policy configurations frequently result in voice quality degradation or complete service disruption.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp medtlv network-policy
Console(config-if)#
```

show lldp config

This command shows LLDP configuration settings for all ports.

Syntax

show lldp config [detail interface]

- detail - Shows configuration summary.
- interface
  - ethernet unit/port

    -unit - Stack unit. (Range: 1)

    -port - Port number. (Range: 1-28)
  - • port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Example

```
Console# show lldp config

LLDP Global Configuation
```

```
 LLDP Enable : Yes
 LLDP Transmit interval : 30
 LLDP Hold Time Multiplier : 4
 LLDP Delay Interval : 2
 LLDP Reinit Delay : 2
 LLDP Notification Interval : 5
 LLDP MED fast start counts : 4

LLDP Port Configuration
Interface |AdminStatus NotificationEnabled
   --------- + ----------- ------------------
     Eth 1/1       | Tx-Rx         True
       Eth 1/2     | Tx-Rx         True
       Eth 1/3     | Tx-Rx         True
       Eth 1/4     | Tx-Rx         True
       Eth 1/5     | Tx-Rx         True

 Console#show lldp config detail ethernet 1/1

LLDP Port Configuration Detail

Port : Eth 1/1
Admin Status : Tx-Rx
        Notification Enabled : True
Basic TLVs Advertised:
        port-description
        system-name
        system-description
        system-capabilities
        management-ip-address
 802.1 specific TLVs Advertised:
        *port-vid
        *vlan-name
        *proto-vlan
        *proto-ident
 802.3 specific TLVs Advertised:
        *mac-phy
        *poe
        *link-agg
        *max-frame
MED Configuration:
MED Notification Enabled : True
MED Enabled TLVs Advertised:
 *med-cap
 *network-policy
 *location
 *extPoe
 *inventory

Console#
```

show lldp info local-device

This command shows LLDP global and interface-specific configuration settings for this device.

Syntax

show lldp info local-device [detail interface]

- detail - Shows detailed information.
- interface
  - ethernet unit/port

    -unit - Stack unit. (Range: 1)

    -port - Port number. (Range: 1-28)
  - • port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Example

```
Console# show lldp info local-device

LLDP Local System Information Chassis Type : MAC Address
Chassis ID : 00-01-02-03-04-05
System Name :
System Description : PLANET 8+2G Managed Switch
System Capabilities Support : Bridge
System Capabilities Enable : Bridge
Management Address : 192.168.0.101 (IPv4)
LLDP Port Information
Interface |PortID Type PortID PortDesc
 --------- + ---------- ---------- -------------------------
 Eth 1/1     |MAC Address      00-01-02-03-04-06 Ethernet Port on unit 1, port 1
 Eth 1/2     |MAC Address      00-01-02-03-04-07 Ethernet Port on unit 1, port 2
 Eth 1/3     |MAC Address      00-01-02-03-04-08 Ethernet Port on unit 1, port 3
 Eth 1/4     |MAC Address      00-01-02-03-04-09 Ethernet Port on unit 1, port 4

Console# show lldp info local-device detail ethernet 1/1

LLDP Port Information Detail

 Port : Eth 1/1
 Port Type : MAC Address
 Port ID : 00-01-02-03-04-06
 Port Desc : Ethernet Port on unit 1, port 1

Console#
```

show lldp info remote-device

This command shows LLDP global and interface-specific configuration settings for remote devices attached to an LLDP-enabled port.

Syntax

show lldp info remote-device [detail interface] detail - Shows detailed information.

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Example

```
Console# show lldp info remote-device
LLDP Remote Devices Information
Interface | ChassisId PortId SysName
 --------- + ----------------- ----------------- --------------------
Eth 1/1    | 00-01-02-03-04-05 00-01-02-03-04-06

Console# show lldp info remote-device detail ethernet 1/1
LLDP Remote Devices Information Detail

 Local PortName:      Eth 1/1
  Chassis Type:       MAC Address
    Chassis Id :      00-01-02-03-04-05
    PortID Type:      MAC Address
    PortID :          00-01-02-03-04-06
    SysName :
    SysDescr :        SGSD-1022
    PortDescr:        Ethernet Port on unit 1, port 1

  SystemCapSupported : Bridge
  SystemCapEnabled : Bridge
  Remote Management Address : 00-01-02-03-04-05 (MAC Address)
  Console#
```

show lldp info statistics

This command shows statistics based on traffic received through all attached LLDP-enabled interfaces.

Syntax

show lldp info statistics [detail interface]

detail - Shows detailed information.

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Example

```
switch# show lldp info statistics

LLDP Device Statistics

  Neighbor Entries List Last Updated : 2450279 seconds
  New Neighbor Entries Count : 1
  Neighbor Entries Deleted Count : 0
  Neighbor Entries Dropped Count : 0
  Neighbor Entries Ageout Count : 0

  Interface | NumFramesRecvd NumFramesSent NumFramesDiscarded
  --------- + -------------- ------------ -----------------

       Eth 1/1    | 10     11             0
       Eth 1/2    | 0      0              0
       Eth 1/3    | 0      0              0
       Eth 1/4    | 0      0              0
       Eth 1/5    | 0      0              0

switch# show lldp info statistics detail ethernet 1/1

 LLDP Port Statistics Detail
  PortName : Eth 1/1

  Frames Discarded : 0
  Frames Invalid : 0
  Frames Received : 12
  Frames Sent : 13
  TLVs Unrecognized : 0
  TLVs Discarded    : 0
  Neighbor Ageouts    : 0
switch#
```

5.23 Class of Service Commands

The commands described in this section allow you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with four priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. You can set the default priority for each interface, the relative weight of each queue, and the mapping of frame priority tags to the switch's priority queues.

Command Group	Function
Priority (Layer 2)	Configures default priority for untagged frames, sets queue weights, and maps class of service tags to hardware queues
Priority (Layer 3 and 4)	Maps IP port and IP DSCP, Precedence, and TOS values to class of service queues

Table 5-76 Priority Commands

5.23.1 Priority Commands (Layer 2)

This section describes commands used to configure Layer 2 traffic priority on the switch.

Command	Function	Mode
queue mode	Sets the queue mode to strict priority, Weighted Round-Robin (WRR), or hybrid	GC
switchport priority default	Sets a port priority for incoming untagged frames	IC
queue bandwidth	Assigns round-robin weights to the priority queues	GC
queue cos map	Assigns class-of-service values to the priority queues	IC
show queue mode	Shows the current queue mode	PE
show queue bandwidth	Shows round-robin weights assigned to the priority queues	PE
show queue cos-map	Shows the class-of-service map	PE
show interfaces switchport	Displays the administrative and operational status of aninterface	PE

Table 5-77 Priority Commands (Layer 2)

queue mode

This command sets the queue mode to strict priority, Weighted Round-Robin (WRR), or or a combination of both for the class of service (CoS) priority queues. Use the no form to restore the default value.

Syntax

queue mode {strict | wrr | hybrid}

no queue mode

- **strict** - Services the egress queues in sequential order, transmitting all traffic in the higher priority queues before

servicing lower priority queues.

- **wrr** - Weighted Round-Robin shares bandwidth at the egress ports by using scheduling weights 1, 2, 4, 8 for queues 0 -3 respectively.
- **hybrid** -Services the highest priority queue (3) according to strict priority queuing, after which the 3 lower priority queues (0, 1, 2) are processed according to their WRR weightings.

Default Setting

Weighted Round Robin

Command Mode

Global Configuration

Command Usage

- The switch can be set to service the port queues based on strict priority, WRR, or a combination of strict and weighted queueing.
- Strict priority requires all traffic in a higher priority queue to be processed before lower priority queues are serviced.
- WRR uses a relative weight for each queue which determines the number of packets the switch transmits every time it services a queue before moving on to the next queue. Thus, a queue weighted 8 will be allowed to transmit up to 8 packets, after which the next lower priority queue will be serviced according to it's weighting. This prevents the head-of-line blocking that can occur with strict priority queuing.
- When using hybrid priority queuing mode, the switch employ strict priority queuing for the highest priority queue (queue 3) before processing queues 2 through 0 according to their WRR weights.

Example

The following example sets the queue mode to strict priority service mode:

```
Console(config)#queue mode strict
Console(config)#
```

switchport priority default

This command sets a priority for incoming untagged frames. Use the no form to restore the default value.

Syntax

switchport priority default default-priority-id

no switchport priority default

default-priority-id - The priority number for untagged ingress traffic.

The priority is a number from 0 to 7. Seven is the highest priority.

Default Setting

The priority is not set, and the default value for untagged frames received on the interface is zero.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.
- This switch provides eight priority queues for each port. It is configured to use Weighted Round Robin, which can be viewed with the **show queue bandwidth** command. Inbound frames that do not have VLAN tags are tagged with the input port's default ingress user priority, and then placed in the appropriate priority queue at the output port. The default priority for all ingress ports is zero. Therefore, any inbound frames that do not have priority tags will be placed in queue 0 of the output port. (Note that if the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.)

Example

The following example shows how to set a default priority on port 3 to 5:

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport priority default 5
Console(config-if)#
```

Related Commands

show interfaces switchport

queue bandwidth

This command assigns weighted round-robin (WRR) weights to the four class of service (CoS) priority queues. Use the no form to restore the default weights.

Syntax

queue bandwidth weight1...weight4

no queue bandwidth

weight1...weight4 -The ratio of weights for queues 0-3 determines the weights used by the WRR scheduler. (Range: 1-15)

Default Setting

Weights 1, 2, 4, 8 are assigned to queues 0-3 respectively.

Command Mode

Global Configuration

Command Usage

WRR controls bandwidth sharing at the egress port by defining scheduling weights for allocated service priorities.

Queue weights must be configured in ascendant manner, assigning more weight to each higher numbered queue (that is, Q0 ≤Q1 ≤Q2 ≤ Q3).

Example

This example shows how to assign WRR weights to priority queues 0 - 2:

```
Console(config)#queue bandwidth 6 9 12
Console(config)#
```

Related Commands

queue mode

show queue bandwidth

queue cos-map

This command assigns class of service (CoS) values to the priority queues (i.e., hardware output queues 0 - 3). Use the no form set the CoS map to the default values.

Syntax

queue cos-map queue_id [cos1 ... cosn]

no queue cos-map

- queue_id - The ID of the priority queue.

  Ranges are 0 to 3, where 3 is the highest priority queue.
- cos1 .. cosn - The CoS values that are mapped to the queue ID. It is a space-separated list of numbers. The CoS value is a number from 0 to 7, where 7 is the highest priority.

Default Setting

This switch supports Class of Service by using four priority queues, with Weighted Round Robin queuing for each port. Eight separate traffic classes are defined in IEEE 802.1p. The default priority levels are assigned according to recommendations in the IEEE 802.1p standard as shown below.

Priority	1,2	0,3	4,5	6,7
Queue	0	1	2	3

Table 5-78 Default CoS Priority Levels

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

CoS values assigned at the ingress port are also used at the egress port.

Example

The following example shows how to change the CoS assignments:

```
Console(config)#interface ethernet 1/1
```

```
Console(config-if)#queue cos-map 0 0
Console(config-if)#queue cos-map 1 1
Console(config-if)#queue cos-map 2 2
Console(config-if)#exit
Console#show queue cos-map ethernet 1/1
Information of Eth 1/1

 Traffic Class : 0 1 2 3 4 5 6 7

 Priority Queue: 0 1 2 1 2 2 3 3
Console#
```

Related Commands

show queue cos-map

show queue mode

This command shows the current queue mode.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show queue mode

Queue mode: wrr
Console#
```

show queue bandwidth

This command displays the weighted round-robin (WRR) bandwidth allocation for the four priority queues.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show queue bandwidth

Queue ID    Weight
 --------    -----
 0           1
 1           2
 2           4
 3           8

Console#
```

show queue cos-map

This command shows the class of service priority map.

Syntax

show queue cos-map [interface] interface

- ethernet unit/port -unit - Stack unit. (Range: 1) -port - Port number. (Range: 1-28)
- port-channel channel-id (Range: 1-12)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console# show queue cos-map ethernet 1/1

Information of Eth 1/1
  Traffic Class : 0 1 2 3 4 5 6 7
  Priority Queue: 1 0 0 1 2 2 3 3

Console#
```

5.23.2 Priority Commands (Layer 3 and 4)

This section describes commands used to configure Layer 3 and Layer 4 traffic priority on the switch

Command	Function	Mode
map ip dscp	Configures IP DSCP to CoS queue mapping	GC
map ip port	Configures TCP port to CoS queue mapping	GC
map ip precedence	Configures IP precedence to CoS queue mapping	GC
map ip tos	Configures IP ToS to CoS queue mapping	GC
map access-list ip	Sets the output queue for packets matching an IP ACL rule	IC
map access-list mac	Sets the output queue for packets matching a MAC ACL rule	IC
show map ip dscp	Shows the IP DSCP map	PE
show map ip port	Shows the IP port map	PE
show map ip precedence	Shows the IP precedence map	PE
show map ip tos	Shows the IP ToS map	PE
show map access-list	Shows CoS value mapped to an access list for an interface	PE

Table 5-79 Priority Commands (Layer 3 and 4)

map ip dscp

This command enables and sets IP DSCP priority mapping (i.e., Differentiated Services Code Point priority mapping). Use the **no** form to restore the defaults.

Syntax

map ip dscp [dscp-value cos cos-queue]

no map ip dscp [dscp-value]

- dscp-value -8-bit DSCP value. (Range: 0-63)
- cos-queue - Port Class-of-Service queue. (Range: 0-3)

Default Setting

Status: Disabled

The DSCP default values are defined in the following table. Note that all the DSCP values that are not specified are mapped to CoS queue 0.

IP DSCP Value	CoS Queue
0, 8	0
10, 12, 14, 16, 18, 20, 22, 24	1
26, 28, 30, 32, 34, 36, 38, 40, 42	2
46, 48, 56	3

Table 5-80 Mapping IP DSCP to CoS Queues

Command Mode

Global Configuration

Command Usage

- The command **map ip dscp** enables the feature on the switch. The command **map ip dscp** dscp-value **cos** cos-queue maps DSCP values to port CoS queues.
- The precedence for priority mapping is IP Port, IP Precedence/DSCP/TOS, and default switchport priority.
- This command sets the IP DSCP priority for all interfaces.
- IP Precedence, IP DSCP, and IP TOS Priority cannot all be enabled at the same time. Enabling one of these priority types automatically disables the others.

Example

The following example shows how to map IP DSCP value 1 to queue 0, then enable the feature on the switch.

```
Console(config)# map ip dscp 1 cos 0
Console(config)# map ip dscp
Console(config)#
```

map ip port

Use this command to enable and set IP port priority mapping (i.e., TCP/UDP port priority mapping). Use the **no** form to disable the feature or remove a settting.

Syntax

map ip port [port-number cos cos-queue]

no map ip port [port-number]

- port-number - 16-bit TCP/UDP port number. (Range: 0-65535)
- cos-queue - Port Class-of-Service queue (Range: 0-3)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- The command **map ip port** enables the feature on the switch. The command **map ip port** port-number **cos** cos-queue maps IP ports to port CoS queues.
- The precedence for priority mapping is IP Port, IP Precedence/DSCP/TOS, and default switchport priority.
- This command sets the IP port priority for all interfaces.

Example

The following example shows how to map HTTP traffic to CoS queue 0, then enable the feature globally on the switch.

```
Console(config)#map ip port 80 cos 0
Console(config)#map ip port
Console(config)#
```

map ip precedence

Use this command to enable and set IP precedence priority mapping. Use the no form to disable the feature or restore a Default Setting.

Syntax

map ip precedence [precedence-value cos cos-queue]

no map ip precedence [precedence-value]

- precedence-value -3-bit precedence value. (Range: 0-7)
- cos-queue - Port Class-of-Service queue. (Range: 0-3)

Default Setting

Status: Disabled

The list below shows the default priority mapping.

IP Precedence Value	0	1	2	3	4	5	6	7
CoS Queue	0	0	1	1	2	2	3	3

Table 5-81 Mapping IP Precedence to CoS Queues

Command Mode

Global Configuration

Command Usage

- The command map ip precedence enables the feature on the switch. The command map ip precedence precedence-value cos cos-queue maps IP Precedence values to port CoS queues.
- The precedence for priority mapping is IP Port, IP Precedence/DSCP/TOS, and default switchport priority.
- This command sets the IP Precedence priority for all interfaces.
- IP Precedence, IP DSCP, and IP TOS Priority cannot all be enabled at the same time. Enabling one of these priority types automatically disables the others.

Example

The following example shows how to map IP precedence value 1 to CoS value 0 and enable the feature on the switch.

```
Console(config)#map ip precedence 1 cos 0
```

```
Console(config)#map ip precedence
Console(config)#
```

map ip tos

Use this command to enable and set IP TOS priority mapping (i.e., IP Type of Service priority mapping). Use the no form to disable the feature or restore a Default Setting.

Syntax

map ip tos [tos-value cos cos-queue]

no map ip tos [tos-value]

tos-value -4-bit TOS value. (Range: 0-15)

cos-queue - Port Class-of-Service queue. (Range: 0-3)

Default Setting

Status: Disabled

The TOS default values are defined in the following table. All the TOS values not defined are mapped to CoS queue 0.

IP TOS Value	Requested Service	Default CoS Output Queue
0	Normal service	0
1	Minimize monetary cost	0
2	Maximize reliability	1
4	Maximize throughput	2
8	Minimize delay	3

Table 5-82 Mapping IP TOS to CoS Queues

Command Mode

Global Configuration

Command Usage

- The command map ip tos enables the feature on the switch. The command map ip tos tos-value cos cos-queue maps IP TOS values to port CoS queues.
- The precedence for priority mapping is IP Port, IP Precedence/DSCP/TOS, and default switchport priority.
- This command sets the IP TOS priority for all interfaces.
- IP Precedence, IP DSCP, and IP TOS Priority cannot all be enabled at the same time. Enabling one of these priority types automatically disables the others.

Example

The following example shows how to map IP TOS value 0 to CoS value 1 and enable the feature on the switch.

```
Console(config)#map ip tos 0 cos 1
Console(config)#map ip tos
```

map access-list ip

This command sets the output queue for packets matching an IP ACL rule. Use the no form to remove the CoS queue mapping.

Syntax

[no] map access-list ip acl_name cos cos-queue

acl_name – Name of the IP ACL. (Maximum length: 16 characters)

cos-queue – Port CoS queue. (Range: 0-3)

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

You must configure an ACL before you can map a CoS queue to the rule.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#map access-list ip bill cos 0
Console(config-if)#
```

map access-list mac

This command sets the output queue for packets matching a MAC ACL rule. Use the no form to remove the CoS queue mapping.

Syntax

[no] map access-list mac acl_name cos cos-queue

acl_name – Name of the MAC ACL. (Maximum length: 16 characters)

cos-queue – Port CoS queue. (Range: 0-3)

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

You must configure an ACL before you can map a CoS queue to the rule.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#map access-list mac steve cos 0
Console(config-if)#
```

show map ip dscp

This command shows the IP DSCP priority map.

Syntax

show map ip dscp

Command Mode

Privileged Exec

Example

```
Console# show map ip dscp
dscp Mapping Status: Disabled

      DSCP     COS
     --------     -------
        0            1
        1            0
        2            0
        3            0
.
       61            0
       62            0
       63            0

Console#
```

Related Commands

map ip dscp

show map ip port

Use this command to show the IP port priority map.

Syntax

show map ip port

Command Mode

Privileged Exec

Example

The following shows that FTP traffic has been mapped to CoS value 2:

```
Console# show map ip port
TCP Port Mapping Status: Disabled

  Port no. COS
  -------- -----
    21       2
Console#
```

Related Commands

map ip port

show map ip precedence

Use this command to show the IP precedence priority map.

Syntax

show map ip precedence

Command Mode

Privileged Exec

Example

```
Console# show map ip precedence
Precedence Mapping Status: Enabled

  Precedence   COS
  ----------   -----
     0          0
     1          0
     2          1
     3          1
     4          2
     5          2
     6          3
     7          3
Console#
```

Related Commands

map ip precedence

show map ip tos

Use this command to show the IP ToS priority map.

Syntax

show map ip tos

Command Mode

Privileged Exec

Class of Service Commands

Example

```
Console# show map ip tos
tos Mapping Status: Disabled

  TOS   COS
  -----   ----
 0        0
  1        0
  2        1
  3        0
  4        2
  5        0
  6        0
  7        0
  8        3
  9        0
  10       0
  11       0
  12       0
  13       0
  14       0
  15       0

Console#
```

Related Commands

map ip tos

show map access-list

This command shows the CoS queue mapped to an ACL for the current interface.

Syntax

show map access-list {ip | mac} [interface]

ip - Specifies IP ACLs.

mac - Specifies MAC ACLs.

interface

-ethernet unit/port

-unit - This is device 1.

-port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show map access-list ip
Eth 1/1
access-list ip aclname cos 3
Console#
```

5.24 Quality of Service Commands

The commands described in this section are used to configure Differentiated Services (DiffServ) classification criteria and service policies. You can classify traffic based on access lists, IP Precedence or DSCP values, or VLANs. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet.

Command	Function	Mode
class-map	Creates a class map for a type of traffic	GC
match	Defines the criteria used to classify traffic	CM
policy-map	Creates a policy map for multiple interfaces	GC
class	Defines a traffic classification for the policy to act on	PM
set	Classifies IP traffic by setting a CoS, DSCP value in a packet	PM-C
police	Defines an enforcer for classified traffic	PM-C
service-policy	Applies a policy map defined by the policy-map command to the input of a particular interface	IC
show class-map	Displays the QoS class maps which define matching criteria used for classifying traffic	PE

show policy-map	Displays the QoS policy maps which define classification criteria for incoming traffic, and may include policers for bandwidth limitations	PE
show policy-map interface	Displays the configuration of all classes configured for all service policies on the specified interface	PE

Table 5-83 Quality of Service Commands

To create a service policy for a specific category of ingress traffic, follow these steps:

1. Use the **class-map** command to designate a class name for a specific category of traffic, and enter the Class Map configuration mode.
2. Use the **match** command to select a specify type of traffic based on an access list, a DSCP or IP Precedence value, or a VLAN.
3. Set an ACL mask to enable filtering for the criteria specified in the **match** command.
4. Use the **policy-map** command to designate a policy name for a specific manner in which ingress traffic will be handled, and enter the Policy Map configuration mode.
5. Use the **class** command to identify the class map, and enter Policy Map Class configuration mode. A policy map can contain multiple class statements.
6. Use the **set** command to modify the QoS value for matching traffic class, and use the **policer** command to monitor the average flow and burst rate, and drop any traffic that exceeds the specified rate, or just reduce the DSCP service level for traffic exceeding the specified rate.
7. Use the **service-policy** command to assign a policy map to a specific interface.

1. You can configure up to 16 rules per Class Map. You can also include multiple classes in a Policy Map.
2. You should create a Class Map (page 4-291) before creating a Policy Map (page 4-292). Otherwise, you will not be able to specify a Class Map with the class command (page 4-293) after entering Policy-Map Configuration mode.

class-map

This command creates a class map used for matching packets to the specified class, and enters Class Map configuration mode. Use the no form to delete a class map and return to Global configuration mode.

Syntax

[no] class-map class-map-name [match-any]

- match-any - Match any condition within a class map.
- class-map-name - Name of the class map. (Range: 1-16 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- First enter this command to designate a class map and enter the Class Map configuration mode. Then use the **match** command to specify the criteria for ingress traffic that will be classified under this class map.
- Up to 16 **match** commands are permitted per class map.
- The class map is used with a policy map to create a service policy for a specific interface that defines packet classification, service tagging, and bandwidth policing.

Example

This example creates a class map call "rd_class," and sets it to match packets marked for DSCP service value 3:

```
Console(config)#class-map rd_class match-any
Console(config-cmap)#match ip dscp 3
Console(config-cmap)#
```

Related Commands

show class map

match

This command defines the criteria used to classify traffic. Use the no form to delete the matching criteria.

Syntax

[no] match access-list acl-name

acl-name -Name of the access control list. Any type of ACL can be specified, including standard or extended IP ACLs and MAC ACLs. (Range: 1-16 characters)

Default Setting

None

Command Mode

Class Map Configuration

Command Usage

- First enter the **class-map** command to designate a class map and enter the Class Map configuration mode. Then use the **match** command to specify the fields within ingress packets that must match to qualify for this class map.
- Only one **match** command can be entered per class map.

Example

This example creates a class map call "rd_class#3," and sets it to match packets defined in an access list:

```
Console(config)#class-map rd_class#3 match-any
Console(config-cmap)#match access-list test-packets
Console(config-cmap)#
```

policy-map

This command creates a policy map that can be attached to multiple interfaces, and enters Policy Map configuration mode. Use the no form to delete a policy map and return to Global configuration mode.

Syntax

[**no**] **policy-map** policy-map-name

policy-map-name -Name of the policy map. (Range: 1-16 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Use the **policy-map** command to specify the name of the policy map, and then use the **class** command to configure policies for traffic that matches criteria defined in a class map.
- A policy map can contain multiple class statements that can be applied to the same interface with the **service-policy** command.
- You must create a Class Map before assigning it to a Policy Map.

Example

This example creates a policy called "rd_policy," uses the **class** command to specify the previously defined "rd_class," uses the **set** command to classify the service that incoming packets will receive, and then uses the **police** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 1522 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd_policy
Console(config-pmap)#class rd_class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police 100000 1522 exceed-action drop
Console(config-pmap-c)#
```

class

This command defines a traffic classification upon which a policy can act, and enters Policy Map Class configuration mode. Use

the no form to delete a class map and return to Policy Map configuration mode.

Syntax

[no] **class** class-map-name

class-map-name -Name of the class map. (Range: 1-16 characters)

Default Setting

None

Command Mode

Policy Map Configuration

Command Usage

- Use the policy-map command to specify a policy map and enter Policy Map configuration mode. Then use the class command to enter Policy Map Class configuration mode. And finally, use the set and police commands to specify the match criteria, where the:

  -**set** command classifies the service that an IP packet will receive.

  -**police** command defines the maximum throughput, burst rate, and the action that results from a policy violation.
- can configure up to 16 rules per Class Map. You can also include multiple classes in a Policy Map.

Example

This example creates a policy called "rd_policy," uses the class command to specify the previously defined "rd_class," uses the set command to classify the service that incoming packets will receive, and then uses the police command to limit the average bandwidth to 100,000 Kbps, the burst rate to 1522 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd_policy
Console(config-pmap)#class rd_class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police 100000 1522 exceed-action drop
Console(config-pmap-c)#
```

set

This command services IP traffic by setting a CoS, DSCP, or IP Precedence value in a matching packet (as specified by the match command on page 4-292). Use the no form to remove the traffic classification.

Syntax

[no] set {cos new-cos | ip dscp new-dscp | ip precedence new-precedence | ipv6 dscp new-dscp}

new-cos -New Class of Service (CoS) value. (Range: 0-7)

new-dscp - New Differentiated Service Code Point (DSCP) value. (Range: 0-63)

new-precedence - New IP Precedence value. (Range: 0-7)

Default Setting

None

Command Mode

Policy Map Class Configuration

Example

This example creates a policy called "rd_policy," uses the class command to specify the previously defined "rd_class," uses the set command to classify the service that incoming packets will receive, and then uses the police command to limit the average bandwidth to 100,000 Kbps, the burst rate to 1522 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd_policy
Console(config-pmap)#class rd_class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police 100000 1522 exceed-action drop
Console(config-pmap-c)#
```

police

This command defines an policer for classified traffic. Use the no form to remove a policer.

Syntax

[no] police rate-kbps burst-byte [exceed-action drop]

rate-kbps -Rate in kilobits per second. (Range: 1-100000 kbps or maximum port speed, whichever is lower)

burst-byte - Burst in bytes. (Range: 64-1522 bytes)

drop - Drop packet when specified rate or burst are exceeded.

Default Setting

Drop out-of-profile packets.

Command Mode

Policy Map Class Configuration

Command Usage

You can configure up to 64 policers (i.e., meters or class maps) for each of the following access list types: MAC ACL, IP ACL (including Standard ACL and Extended ACL).

Policing is based on a token bucket, where bucket depth (i.e., the maximum burst before the bucket overflows) is by specified the burst-byte field, and the average rate at which tokens are removed from the bucket is specified by the rate-kbps option.

Example

This example creates a policy called "rd_policy," uses the class command to specify the previously defined "rd_class,"

uses the set command to classify the service that incoming packets will receive, and then uses the police command to limit the average bandwidth to 100,000 Kbps, the burst rate to 1522 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd_policy
Console(config-pmap)#class rd_class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police 100000 1522 exceed-action drop
Console(config-pmap-c)#
```

service-policy

This command applies a policy map defined by the policy-map command to the ingress queue of a particular interface. Use the no form to remove the policy map from this interface.

Syntax

[no] service-policy input policy-map-name

input - Apply to the input traffic.

policy-map-name - Name of the policy map for this interface. (Range: 1-16 characters)

Default Setting

No policy map is attached to an interface.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

You can only assign one policy map to an interface.

You must first define a class map, then define a policy map, and finally use the service-policy command to bind the policy map to the required interface.

Example

This example applies a service policy to an ingress interface.

```
Console(config)#interface ethernet 1/1
Console(config-if)#service-policy input rd_policy
Console(config-if)#
```

show class-map

This command displays the QoS class maps which define matching criteria used for classifying traffic.

Syntax

show class-map [class-map-name] class-map-name -Name of the class map. (Range: 1-16 characters)

Default Setting

Displays all class maps.

Command Mode

Privileged Exec

Quality of Service Commands

Example

```
Console#show class-map
Class Map match-any rd_class#1
  Match ip dscp 3

Class Map match-any rd_class#2
  Match ip precedence 5

Class Map match-any rd_class#3
  Match vlan 1

Console#
```

show policy-map

This command displays the QoS policy maps which define classification criteria for incoming traffic, and may include policers for bandwidth limitations.

Syntax

show policy-map [policy-map-name [class class-map-name]]

policy-map-name - Name of the policy map. (Range: 1-16 characters)

class-map-name - Name of the class map. (Range: 1-16 characters)

Default Setting

Displays all policy maps and all classes.

Command Mode

Privileged Exec

Example

```
Console#show policy-map
Policy Map rd_policy
 class rd_class

  set ip dscp 3
Console#show policy-map rd_policy class rd_class
Policy Map rd_policy

 class rd_class
  set ip dscp 3
Console#
```

show policy-map interface

This command displays the service policy assigned to the specified interface.

Syntax

show policy-map interface interface input

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

port-channel channel-id (Range: 1-12)

Command Mode

Privileged Exec

Example

```
Console#show policy-map interface ethernet 1/5
Service-policy rd_policy input
Console#
```

5.25 Multicast Filtering Commands

This switch uses IGMP (Internet Group Management Protocol) to query for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting a service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service.

Command Groups	Function
IGMP Snooping	Configures multicast groups via IGMP snooping or static assignment, sets the IGMP version, displays current snooping and query settings, and displays the multicast service and group members
IGMP Query	Configures IGMP query parameters for multicast filtering at Layer 2
Static Multicast Routing	Configures static multicast router ports
IGMP Filtering and Throttling	Configures IGMP filtering and throttling
Multicast VLAN Registration	Configures a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation for normal traffic

Table 5-84 Multicast Filtering Commands

5.25.1 IGMP Snooping Commands

This section describes commands used to configure IGMP snooping on the switch.

Command	Function	Mode
ip igmp snooping	Enables IGMP snooping	GC
ip igmp snooping vlan static	Adds an interface as a member of a multicast group	GC
ip igmp snooping version	Configures the IGMP version for snooping	GC
ip igmp snoopingleave-proxy	Enables IGMP leave proxy on the switch	GC
ip igmp snoopingimmediateleave	Immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN	IC
show ip igmp snooping	Shows the IGMP snooping and query configuration	PE
show mac-address-table multicast	Shows the IGMP snooping MAC multicast list	PE

Table 5-85 IGMP Snooping Commands

ip igmp snooping

This command enables IGMP snooping on this switch. Use the no form to disable it.

Syntax

[no] ip igmp snooping

Default Setting

Enabled

Command Mode

Global Configuration

Example

The following example enables IGMP snooping.

```
Console(config)#ip igmp snooping
Console(config)#
```

ip igmp snooping vlan static

This command adds a port to a multicast group. Use the no form to remove the port.

Syntax

[no] ip igmp snooping vlan vlan-id static ip-address interface

vlan-id -VLAN ID (Range: 1-4094)

ip-address -IP address for multicast group

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

None

Command Mode

Global Configuration

Example

The following shows how to statically configure a multicast group on a port:

```
Console(config)#ip igmp snooping vlan 1 static 224.0.0.12 ethernet 1/5
Console(config)#
```

ip igmp snooping version

This command configures the IGMP snooping version. Use the no form to restore the default.

Syntax

ip igmp snooping version {1 | 2 | 3}

no ip igmp snooping version

1 - IGMP Version 1

2 - IGMP Version 2

3 - IGMP Version 3

Default Setting

IGMP Version 2

Command Mode

Global Configuration

Command Usage

All systems on the subnet must support the same version. If there are legacy devices in your network that only support Version 1, you will also have to configure this switch to use Version 1.

Some commands are only enabled for IGMPv2 and/or v3, including ip igmp snooping querier, ip igmp snooping query-max-response-time, ip igmp snooping query-interval, and ip igmp snooping immediate leave.

Example

The following configures the switch to use IGMP Version 1:

```
Console(config)#ip igmp snooping version 1
Console(config)#
```

ip igmp snooping leave-proxy

This command enables IGMP leave proxy on the switch. Use the no form to disable the feature.

Syntax

[no] ip igmp snooping leave-proxy

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The IGMP snooping leave-proxy feature suppresses all unnecessary IGMP leave messages so that the non-querier switch forwards an IGMP leave packet only when the last dynamic member port leaves a multicast group.

The leave-proxy feature does not function when a switch is set as the querier.

Example

```
Console(config)#ip igmp snooping leave-proxy
```

```
Console(config)#
```

ip igmp snooping immediate-leave

This command immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN. Use the no form to restore the default.

Syntax

[no] ip igmp snooping immediate-leave vlan-id

vlan-id - VLAN ID (1 to 4094)

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

If immediate-leave is not used, a multicast router (or querier) will send a group-specific query message when an IGMPv2 or IGMPv3 group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified timeout period. Note that the timeout period is determined by ip igmp snooping query-max-response-time (see 4-305).

If immediate-leave is enabled, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, eiter a service host or a neighbor running IGMP snooping.

This command is only effective if IGMP snooping is enabled, and IGMPv2 or IGMPv3 snooping is used.

Example

The following shows how to enable immediate leave.

```
Console(config)#interface vlan 1
Console(config-if)#ip igmp snooping immediate-leave
Console(config-if)#
```

show ip igmp snooping

This command shows the IGMP snooping configuration.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

See "Configuring IGMP Snooping and Query Parameters" on page 3-239 for a description of the displayed items.

Example

The following shows the current IGMP snooping configuration: .

```
Console#show ip igmp snooping

  Service status:              Enabled
  Querier status:              Enabled
  Leave proxy status:          Disabled
  Query count:                 10
  Query interval:              100 sec

 Query max response time: 20 sec
 Router port expire time: 300 sec
 Immediate Leave Processing: Disabled on all VLAN
 IGMP snooping version: Version 2

Console#
```

show mac-address-table multicast

This command shows known multicast addresses.

Syntax

show mac-address-table multicast [vlan vlan-id] [user | igmp-snooping]

vlan-id - VLAN ID (1 to 4094)

user -Display only the user-configured multicast entries.

igmp-snooping -Display only entries learned through IGMP snooping.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Member types displayed include IGMP or USER, depending on selected options.

Example

The following shows the multicast entries learned through IGMP snooping for VLAN 1:

```
Console#show mac-address-table multicast vlan 1 igmp-snooping
 VLAN M'cast IP addr. Member ports Type
```

```
---- --------------- ------------ ------
1 224.1.2.3 Eth1/11 IGMP
Console#
```

5.25.2 IGMP Query Commands (Layer 2)

This section describes commands used to configure Layer 2 IGMP query on the switch.

Command	Function	Mode
ip igmp snooping querier	Allows this device to act as the querier for IGMP snooping	GC
ip igmp snooping query-count	Configures the query count	GC
ip igmp snoopingquery-interval	Configures the query interval	GC
ip igmp snoopingquery-max-response-time	Configures the report delay	GC
ip igmp snoopingrouter-port-expire-time	Configures the query timeout	GC

Table 5-86 IGMP Query Commands (Layer 2)

ip igmp snooping querier

This command enables the switch as an IGMP querier. Use the no form to disable it.

Syntax

[no] ip igmp snooping querier

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

IGMP snooping querier is not supported for IGMPv3 snooping (see ip igmp snooping version, page 4-300).

If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.

Example

```
Console(config)#ip igmp snooping querier
Console(config)#
```

ip igmp snooping query-count

This command configures the query count. Use the no form to restore the default.

Syntax

ip igmp snooping query-count count no ip igmp snooping query-count

count - The maximum number of queries issued for which there has been no response before the switch takes action to drop a client from the multicast group. (Range: 2-10)

Default Setting

2 times

Command Mode

Global Configuration

Command Usage

The query count defines how long the querier waits for a response from a multicast client before taking action. If a querier has sent a number of queries defined by this command, but a client has not responded, a countdown timer is started using the time defined by ip igmp snooping query-maxresponse-time. If the countdown finishes, and the client still has not responded, then that client is considered to have left the multicast group.

Example

The following shows how to configure the query count to 10:

```
Console(config)#ip igmp snooping query-count 10
Console(config)#
```

Related Commands

ip igmp snooping query-max-response-time

ip igmp snooping query-interval

This command configures the query interval. Use the no form to restore the default.

Syntax

ip igmp snooping query-interval seconds

no ip igmp snooping query-interval

seconds -The frequency at which the switch sends IGMP host-query messages. (Range: 60-125)

Default Setting

125 seconds

Command Mode

Global Configuration

Example

The following shows how to configure the query interval to 100 seconds:

```
Console(config)#ip igmp snooping query-interval 100
Console(config)#
```

ip igmp snooping query-max-response-time

This command configures the query report delay. Use the no form to restore the default.

Syntax

ip igmp snooping query-max-response-time seconds

no ip igmp snooping query-max-response-time

seconds -The report delay advertised in IGMP queries. (Range: 5-25)

Default Setting

10 seconds

Command Mode

Global Configuration

Command Usage

The switch must be using IGMPv2 or v3 snooping for this command to take effect.

This command defines the time after a query, during which a response is expected from a multicast client. If a querier has sent a number of queries defined by the ip igmp snooping query-count, but a client has not responded, a countdown timer is started using an initial value set by this command. If the countdown finishes, and the client still has not responded, then that client is considered to have left the multicast group.

Example

The following shows how to configure the maximum response time to 20 seconds:

```
Console(config)#ip igmp snooping query-max-response-time 20
Console(config)#
```

Related Commands

ip igmp snooping version

ip igmp snooping router-port-expire-time

This command configures the query timeout. Use the no form to restore the default.

Syntax

ip igmp snooping router-port-expire-time seconds no ip igmp snooping router-port-expire-time

seconds - The time the switch waits after the previous querier stops before it considers the router port (i.e., the interface which had been receiving query packets) to have expired. (Range: 300-500)

Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

The switch must use IGMPv2 or v3 snooping for this command to take effect.

Example

The following shows how to configure the default timeout to 300 seconds:

```
Console(config)#ip igmp snooping router-port-expire-time 300
Console(config)#
```

Related Commands

ip igmp snooping version

5.25.3 Static Multicast Routing Commands

This section describes commands used to configure static multicast routing on the switch.

Command	Function	Mode
ip igmp snooping vlan mrouter	Adds a multicast router port	GC
show ip igmp snooping mrouter	Shows multicast router ports	PE

Table 5-87 Static Multicast Routing Commands

ip igmp snooping vlan mrouter

This command statically configures a multicast router port. Use the no form to remove the configuration.

Syntax

[no] ip igmp snooping vlan vlan-id mrouter interface

vlan-id -VLAN ID (Range: 1-4094)

interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

No static multicast router ports are configured.

Command Mode

Global Configuration

Command Usage

Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/switch connected over the network to an interface (port or trunk) on your router, you can manually configure that interface to join all the current multicast groups.

Example

The following shows how to configure port 11 as a multicast router port within VLAN 1:

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#
```

show ip igmp snooping mrouter

This command displays information on statically configured and dynamically learned multicast router ports.

Syntax

show ip igmp snooping mrouter [vlan vlan-id] vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Displays multicast router ports for all configured VLANs.

Command Mode

Privileged Exec

Command Usage

Multicast router port types displayed include Static or Dynamic.

Example

The following shows that port 11 in VLAN 1 is attached to a multicast router:

```
Console# show ip igmp snooping mrouter vlan 1
 VLAN      M'cast Router Ports      Type
 ---------      -------------------         --------------
 1              Eth 1/11      Static
 2              Eth 1/12      Dynamic
 Console#
```

5.25.4 IGMP Filtering and Throttling Commands

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For Example, an IP/TV service based on a specific subscription plan. The IGMP filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and IGMP throttling limits the number of simultaneous multicast groups a port can join.

Command	Function	Mode
ip igmp filter	Enables IGMP filtering and throttling on the switch	GC
ip igmp profile	Sets a profile number and enters IGMP filter profileconfiguration mode	GC
permit, deny	Sets a profile access mode to permit or deny	IPC
range	Specifies one or a range of multicast addresses for a profile	IPC
ip igmp filter	Assigns an IGMP filter profile to an interface	IC
ip igmp max-groups	Specifies an IGMP throttling number for an interface	IC
ip igmp max-groups action	Sets the IGMP throttling action for an interface	IC
show ip igmp filter	Displays the IGMP filtering status	PE
show ip igmp profile	Displays IGMP profiles and settings	PE
show ip igmp throttle interface	Displays the IGMP throttling setting for interfaces	PE

Table 5-88 IGMP Filtering and Throttling Commands

ip igmp filter (Global Configuration)

This command globally enables IGMP filtering and throttling on the switch. Use the no form to disable the feature.

Syntax

[no] ip igmp filter

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

IGMP filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An IGMP filter profile can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, IGMP join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the IGMP join report is forwarded as normal. If a requested multicast group is denied, the IGMP join report is dropped.

IGMP filtering and throttling only applies to dynamically learned multicast groups, it does not apply to statically configured groups.

The IGMP filtering feature operates in the same manner when MVR is used to forward multicast traffic.

Example

```
Console(config)#ip igmp filter
Console(config)#
```

ip igmp profile

This command creates an IGMP filter profile number and enters IGMP profile configuration mode. Use the no form to delete a profile number.

Syntax

[no] ip igmp profile profile-number profile-number - An IGMP filter profile number. (Range: 1-4294967295)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

A profile defines the multicast groups that a subscriber is permitted or denied to join. The same profile can be applied to many interfaces, but only one profile can be assigned to one interface. Each profile has only one access mode; either permit or deny.

Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#
```

permit, deny

This command sets the access mode for an IGMP filter profile. Use the no form to delete a profile number.

Syntax

{permit | deny}

Default Setting

Deny

Command Mode

IGMP Profile Configuration

Command Usage

Each profile has only one access mode; either permit or deny.

When the access mode is set to permit, IGMP join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, IGMP join reports are only processed when a multicast group is not in the controlled range.

Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#permit
Console(config-igmp-profile) #
```

range

This command specifies multicast group addresses for a profile. Use the no form to delete addresses from a profile.

Syntax

[no] range low-ip-address [high-ip-address]

low-ip-address - A valid IP address of a multicast group or start of a group range.

high-ip-address - A valid IP address for the end of a multicast group range.

Default Setting

None

Command Mode

IGMP Profile Configuration

Command Usage

Enter this command multiple times to specify more than one multicast address or address range for a profile.

Example

```
Console(config-igmp-profile)#range 239.1.1.1
Console(config-igmp-profile)#range 239.2.3.1 239.2.3.100
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#
```

ip igmp filter (Interface Configuration)

This command assigns an IGMP filtering profile to an interface on the switch. Use the no form to remove a profile from an

interface.

Syntax

[no] ip igmp filter profile-number

profile-number - An IGMP filter profile number. (Range: 1-4294967295)

Default Setting

None

Command Mode

Interface Configuration

Command Usage

The IGMP filtering profile must first be created with the ip igmp profile command before being able to assign it to an interface.

Only one profile can be assigned to an interface.

A profile can also be assigned to a trunk interface. When ports are configured as trunk members, the trunk uses the filtering profile assigned to the first port member in the trunk.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp filter 19
Console(config-if)#
```

ip igmp max-groups

This command sets the IGMP throttling number for an interface on the switch. Use the no form to restore the **Default Setting**.

Syntax

ip igmp max-groups number no ip igmp max-groups

number - The maximum number of multicast groups an interface can join at the same time. (Range: 0-64)

Default Setting

64

Command Mode

Interface Configuration

Command Usage

IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace." If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

IGMP throttling can also be set on a trunk interface. When ports are configured as trunk members, the trunk uses the

throttling settings of the first port member in the trunk.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups 10
Console(config-if)#
```

ip igmp max-groups action

This command sets the IGMP throttling action for an interface on the switch.

Syntax

ip igmp max-groups action {replace | deny}

replace - The new multicast group replaces an existing group.

deny - The new multicast group join report is dropped.

Default Setting

Deny

Command Mode

Interface Configuration

Command Usage

When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace." If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups action replace
Console(config-if)#
```

show ip igmp filter

This command displays the global and interface settings for IGMP filtering.

Syntax

show ip igmp filter [interface interface] interface

• ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ip igmp filter
IGMP filter enabled
Console#show ip igmp filter interface ethernet 1/1
Ethernet 1/1 information


 IGMP Profile 19
   Deny
   range 239.1.1.1 239.1.1.1
   range 239.2.3.1 239.2.3.100


Console#
```

show ip igmp profile

This command displays IGMP filtering profiles created on the switch.

Syntax

show ip igmp profile [profile-number] profile-number - An existing IGMP filter profile number. (Range: 1-4294967295)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ip igmp profile
IGMP Profile 19
IGMP Profile 50
Console#show ip igmp profile 19
IGMP Profile 19
```

```
   Deny
   range 239.1.1.1 239.1.1.1
   range 239.2.3.1 239.2.3.100

Console#
```

show ip igmp throttle interface

This command displays the interface settings for IGMP throttling.

Syntax

show ip igmp throttle interface [interface] interface

• ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28)

• port-channel channel-id (Range: 1-12)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Using this command without specifying an interface displays all interfaces.

Multicast Filtering Commands

Example

```
Console#show ip igmp throttle interface ethernet 1/1

Eth 1/1 Information
   Status : TRUE
   Action : Deny
   Max Multicast Groups : 32
   Current Multicast Groups : 0

Console#
```

5.25.5 Multicast VLAN Registration Commands

This section describes commands used to configure **Multicast VLAN Registration (MVR)**. A single network-wide VLAN can be used to transmit multicast traffic (such as television channels) across a service provider's network. Any multicast traffic entering an MVR VLAN is sent to all subscribers. This can significantly reduce to processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. Also note that MVR maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong.

Command	Function	Mode
mvr	Globally enables MVR, statically configures MVR group address(es), orspecifies the MVR VLAN identifier	GC
mvr	Configures an interface as an MVR receiver or source port, enablesimmediate leave capability, or configures an interface as a staticmember of the MVR VLAN	IC
show mvr	Shows information about the global MVR configuration settings, theinterfaces attached to the MVR VLAN, or the multicast groups assignedto the MVR VLAN	PE

Table 5-89 Multicast VLAN Registration Commands

mvr (Global Configuration)

This command enables Multicast VLAN Registration (MVR) globally on the switch, statically configures MVR multicast group IP address(es) using the group keyword, or specifies the MVR VLAN identifier using the vlan keyword. Use the no form of this command without any keywords to globally disable MVR. Use the no form with the group keyword to remove a specific address or range of addresses. Or use the no form with the vlan keyword restore the default MVR VLAN.

Syntax

[no] mvr [group ip-address [count] | vlan vlan-id]

ip-address -IP address for an MVR multicast group.

(Range: 224.0.1.0 -239.255.255.255)

count - The number of contiguous MVR group addresses. (Range: 1-255)

vlan-id - MVR VLAN ID (Range: 1-4094)

Default Setting

MVR is disabled.

No MVR group address is defined.

The default number of contiguous addresses is 0.

MVR VLAN ID is 1.

Command Mode

Global Configuration

Command Usage

- Use the **mvr group** command to statically configure all multicast group addresses that will join the MVR VLAN. Any multicast data associated an MVR group is sent from all source ports, and to all receiver ports that have registered to receive data from that multicast group.
- The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- MVR source ports can be configured as members of the MVR VLAN using the **switchport allowed vlan** command and **switchport native vlan** command, but MVR receiver ports should not be statically configured as members of this VLAN.
- IGMP snooping must be enabled to a allow a subscriber to dynamically join or leave an MVR group (see **ip igmp snooping**). Note that only IGMP version 2 or 3 hosts can issue multicast join or leave messages.
- Note that only IGMPv1/v2 multicast report messages or IGMPv2 leave messages sent by IGMPv1/v2 hosts are supported by the current MVR standard.
- IGMP snooping and MVR share a maximum number of 255 groups. Any multicast streams received in excess of this limitation will be flooded to all ports in the associated VLAN.

Example

The following example enables MVR globally, designates the MVR VLAN as VLAN 1, and configures a range of MVR group addresses:

```
Console(config)#mvr
Console(config)#mvr vlan 1
Console(config)#mvr group 228.1.23.1 10
Console(config)#
```

mvr (Interface Configuration)

This command configures an interface as an MVR receiver or source port using the type keyword, enables immediate leave capability using the immediate keyword, or configures an interface as a static member of the MVR VLAN using the group keyword. Use the no form to restore the Default Settings.

Syntax

[no] mvr {type {receiver | source} | immediate | group ip-address}

receiver -Configures the interface as a subscriber port that can receive multicast data.

source - Configure the interface as an uplink port that can send and receive multicast data for the configured multicast groups.

immediate - Configures the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group.

ip-address - Statically configures an interface to receive multicast traffic from the IP address specified for an MVR

multicast group. (Range: 224.0.1.0 -239.255.255.255)

Default Setting

The port type is not defined.

Immediate leave is disabled.

No receiver port is a member of any configured multicast group.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A port which is not configured as an MVR receiver or source port can use IGMP snooping to join or leave multicast groups using the standard rules for multicast filtering.
- Receiver ports can belong to different VLANs, but should not be configured as a member of the MVR VLAN. IGMP snooping can be used to allow a receiver port to dynamically join or leave multicast groups within the MVR VLAN. Multicast groups can also be statically assigned to a receiver port using the **group** keyword. However, if a receiver port is statically configured as a member of an MVR VLAN, its status will be inactive. Also, note that VLAN membership for MVR receiver ports cannot be set to trunk mode (see the **switchport mode** command).
- One or more interfaces may be configured as MVR source ports. A source port is able to both receive and send data for multicast groups which it has joined through IGMP snooping or which have been statically assigned using the **group** keyword.
- The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.
- Using immediate leave can speed up leave latency, but should only be enabled on a port attached to one multicast subscriber to avoid disrupting services to other group members attached to the same interface.
- Immediate leave does not apply to multicast groups which have been statically assigned to a port.
- IGMP snooping must be enabled to allow a subscriber to dynamically join or leave an MVR group (see **ip igmp snooping**). Note that only IGMP version 2 or 3 hosts can issue multicast join or leave messages.

Example

The following configures one source port and several receiver ports on the switch, enables immediate leave on one of the receiver ports, and statically assigns a multicast group to another receiver port:

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr type source
Console(config-if)#exit
Console(config)#interface ethernet 1/6
Console(config-if)#mvr type receiver
Console(config-if)#mvr immediate
Console(config-if)#exit
Console(config)#interface ethernet 1/7
Console(config-if)#mvr type receiver
Console(config-if)#mvr group 225.0.0.5
Console(config-if)#
```

show mvr

This command shows information about the global MVR configuration settings when entered without any keywords, the interfaces attached to the MVR VLAN using the interface keyword, or the multicast groups assigned to the MVR VLAN using the members keyword.

Syntax

show mvr [interface [interface] | members [ip-address]]

• interface

ethernet unit/port

-unit - Stack unit. (Range: 1)

-port - Port number. (Range: 1-28

port-channel channel-id (Range: 1-12)

ip-address -IP address for an MVR multicast group.

(Range: 224.0.1.0 -239.255.255.255)

Default Setting

Displays global configuration settings for MVR when no keywords are used.

Command Mode

Privileged Exec

Command Usage

Enter this command without any keywords to display the global settings for MVR. Use the interface keyword to display information about interfaces attached to the MVR VLAN. Or use the members keyword to display information about multicast groups assigned to the MVR VLAN.

Example

The following shows the global MVR settings:

```
Console# show mvr
MVR Status:enable
MVR running status:TRUE
MVR multicast vlan:1
MVR Max Multicast Groups:255
MVR Current multicast groups:10
Console#
```

Field	Description
MVR Status	Shows if MVR is globally enabled on the switch.
MVR running status	Indicates whether or not all necessary conditions in the MVR environment are satisfied.
MVR multicast vlan	Shows the VLAN used to transport all MVR multicast traffic.
MVR Max Multicast Groups	Shows the maximum number of multicast groups which can assigned to the MVR VLAN.
MVR Current multicast groups	Shows the number of multicast groups currently assigned to the MVR VLAN.

Table 5-90 show mvr - display description

The following displays information about the interfaces attached to the MVR VLAN:

```
Console# show mvr interface
Port        Type          Status             Immediate Leave
---------  ----------  --------------------  -----------------------
 eth1/1    SOURCE       ACTIVE/UP             Disable
 eth1/2    RECEIVER     ACTIVE/UP             Disable
 eth1/5    RECEIVER     INACTIVE/DOWN         Disable
 eth1/6    RECEIVER     INACTIVE/DOWN         Disable
 eth1/7    RECEIVER     INACTIVE/DOWN         Disable
 Console#
```

Field	Description
Port	Shows interfaces attached to the MVR.
Type	Shows the MVR port type.
Status	Shows the MVR status and interface status. MVR status for source ports is"ACTIVE" if MVR is globally enabled on the switch. MVR status for receiverports is "ACTIVE" only if there are subscribers receiving multicast traffic from one of the MVR groups, or a multicast group has been statically assigned to an

	interface.
Immediate Leave	Shows if immediate leave is enabled or disabled.

Table 5-91 show mvr interface - display description

The following shows information about the interfaces associated with multicast groups assigned to the MVR VLAN:

```
Console# show mvr members
MVR Group IP     Status      Members
---------------- ----------  ----------------
225.0.0.1        ACTIVE      eth1/1(d), eth1/2(s)
225.0.0.2        INACTIVE    None
225.0.0.3        INACTIVE    None
225.0.0.4        INACTIVE    None
225.0.0.5        INACTIVE    None
225.0.0.6        INACTIVE    None
225.0.0.7        INACTIVE    None
225.0.0.8        INACTIVE    None
225.0.0.9        INACTIVE    None
225.0.0.10       INACTIVE    None
Console#
```

Field	Description
MVR Group IP	Multicast groups assigned to the MVR VLAN.
Status	Shows whether or not the there are active subscribers for this multicast group. Note that this field will also display "INACTIVE" if MVR is globally disabled.
Members	Shows the interfaces with subscribers for multicast services provided through the MVR VLAN. Also shows if an interface has dynamically joined a multicast group (d), or if a multicast group has been statically bound to the interface (s).

Table 5-92 show mvr members - display description

5.26 IP Interface Commands

An IP addresses may be used for management access to the switch over your network. The IP address for this switch is obtained via DHCP by default. You can manually configure a specific IP address, or direct the device to obtain an address from a BOOTP or DHCP server. You may also need to a establish a default gateway between this device and management stations that exist on another network segment.

Command	Function	Mode
ip address	Sets the IP address for the current interface	IC
ip default-gateway	Defines the default gateway through which this switch can reach other subnetworks	GC
ip dhcp restart	Submits a BOOTP or DHCP client request	PE
show ip interface	Displays the IP settings for this device	PE
show ip redirects	Displays the default gateway configured for this device	PE
ping	Sends ICMP echo request packets to another node on thenetwork	NE, PE

Table 5-93 IP Interface Commands

ip address

This command sets the IP address for the currently selected VLAN interface. Use the no form to restore the default IP address.

Syntax

ip address {ip-address netmask | bootp | dhcp} no ip address

ip-address -IP address

netmask - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.

bootp - Obtains IP address from BOOTP.

dhcp - Obtains IP address from DHCP.

Default Setting

DHCP

Command Mode

Interface Configuration (VLAN)

Command Usage

You must assign an IP address to this device to gain management access over the network. You can manually configure a specific IP address, or direct the device to obtain an address from a BOOTP or DHCP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the configuration program.

If you select the bootp or dhcp option, IP is enabled but will not function until a BOOTP or DHCP reply has been received.

Requests will be broadcast periodically by this device in an effort to learn its IP address. (BOOTP and DHCP values can include the IP address, default gateway, and subnet mask).

You can start broadcasting BOOTP or DHCP requests by entering an ip dhcp restart command, or by rebooting the switch.

Only one VLAN interface can be assigned an IP address (the default is VLAN 1). This defines the management VLAN, the only VLAN through which you can gain management access to the switch. If you assign an IP address to any other VLAN, the new IP address overrides the original IP address and this becomes the new management VLAN.

Example

In the following example, the device is assigned an address in VLAN 1.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#
```

Related Commands

ip dhcp restart

ip default-gateway

This command establishes a static route between this switch and devices that exist on another network segment. Use the no form to remove the static route.

Syntax

ip default-gateway gateway no ip default-gateway

gateway - IP address of the default gateway

Default Setting

No static route is established.

Command Mode

Global Configuration

Command Usage

A gateway must be defined if the management station is located in a different IP segment.

Example

The following example defines a default gateway for this device:

```
Console(config)#ip default-gateway 10.1.1.254
Console(config)#
```

Related Commands

show ip redirects

ip dhcp restart

This command submits a BOOTP or DHCP client request.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

This command issues a BOOTP or DHCP client request for any IP interface that has been set to BOOTP or DHCP mode via the ip address command.

DHCP requires the server to reassign the client's last address if available.

If the BOOTP or DHCP server has been moved to a different domain, the network portion of the address provided to the client will be based on this new domain.

Example

In the following example, the device is reassigned the same address.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#end
Console#ip dhcp restart
Console#show ip interface
IP address and netmask: 192.168.1.54 255.255.255.0 on VLAN 1,
and address mode: DHCP.
Console#
```

Related Commands

ip address

show ip interface

This command displays the settings of an IP interface.

Default Setting

All interfaces

Command Mode

Privileged Exec

Example

```
Console#show ip interface
 IP address and netmask: 192.168.1.54 255.255.255.0 on VLAN 1,
 and address mode: User specified.

Console#
```

Related Commands

show ip redirects

show ip redirects

This command shows the default gateway configured for this device.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ip redirects
IP default gateway 10.1.0.254
Console#
```

Related Commands

ip default-gateway

ping

This command sends ICMP echo request packets to another node on the network.

Syntax

ping host [count count][size size] host - IP address of the host.

count - Number of packets to send. (Range: 1-16)

size - Number of bytes in a packet. (Range: 32-512) The actual packet size will be eight bytes larger than the size specified because the router adds header information.

Default Setting

count: 5

size: 32

Command Mode

Normal Exec, Privileged Exec

Command Usage

Use the ping command to see if another site on the network can be reached.

• The following are some results of the ping command: -Normal response - The normal response occurs in one to ten seconds, depending on network traffic. -Destination does not respond - If the host does not respond, a "timeout" appears in ten seconds. -Destination unreachable - The gateway for this destination indicates that the destination is unreachable. - Network or host unreachable - The gateway found no corresponding entry in the route table.

Press <Esc> to stop pinging.

IP Interface Commands

Example

```
Console#ping 10.1.0.9

Type ESC to abort.

PING to 10.1.0.9, by 5 32-byte payload ICMP packets, timeout is 5 seconds

response time: 10 ms

response time: 10 ms

response time: 10 ms

response time: 10 ms

response time: 10 ms

Ping statistics for 10.1.0.9:
  5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)

Approximate round trip times:
  Minimum = 10 ms, Maximum = 20 ms, Average = 10 ms

Console#
```

6. CLI CONFIGURATION (To be Continued)

The section explains how to manage the Managed Switch by Command Line interface.

System

System Information

```
Console(config)# hostname R&D 5
Console(config)# snmp-server location WC 9
Console(config)# snmp-server contact Ted
Console(config)# exit
Console# show system
System Description: Layer2+ Fast Ethernet Standalone Switch SGSD-1022
System OID String: 1.3.6.1.4.1.259.6.10.103
System Information
  System Up Time:              0 days, 0 hours, 57 minutes, and 56.69 seconds
  System Name: R&D 5
  System Location: WC 9
  System Contact: Ted
  MAC Address (Unit1):    00-30-4F-3F-D2-4E
  Web Server: Enabled
  Web Server Port: 80
  Web Secure Server:    Enabled
  Web Secure Server Port:    443
  Telnet Server: Enable
  Telnet Server Port:    23
  Jumbo Frame: Disabled

  POST Result:
DUMMY Test 1 ................ PASS
UART Loopback Test ........... PASS
DRAM Test ..................... PASS
Switch Int Loopback Test ..... PASS

Done All Pass.
Console#
```

Switch Information

```
Console# show version

 Serial Number:            0012CF422DC0
 Service Tag:
 Hardware Version:         R0B
 EPLD Version:             0.00
 Number of Ports:          28
 Main Power Status:        Up
 Loader Version:           1.0.0.2
 Boot ROM Version:         0.0.1.1
 Operation Code Version:   0.0.3.5

Console#
```

Display Bridge Extension Capabilities

```
Console# show bridge-ext
   Max Support VLAN Numbers:              256
   Max Support VLAN ID:                   4094
   Extended Multicast Filtering Services: No
   Static Entry Individual Port:          Yes
   VLAN Learning:                         IVL
   Configurable PVID Tagging:             Yes
   Local VLAN Capable:                    No
   Traffic Classes:                       Enabled
   Global GVRP Status:                    Disabled
   GMRP:                                  Disabled
Console#
```

IP Address Configuration

Manual IP Configuration

```
Console#config
Console(config)# interface vlan 1
Console(config-if)# ip address 192.168.1.1 255.255.255.0
Console(config-if)# exit
Console(config)# ip default-gateway 192.168.1.253
Console(config)#
```

Using DHCP/BOOTP

If your network provides DHCP/BOOTP services, you can configure the switch to be dynamically configured by these services.

```
Console#config
Console(config)# interface vlan 1
Console(config-if)# ip address dhcp
Console(config-if)# end
Console(config)# ip dhcp restart
Console(config)# show ip interface
IP address and netmask: 192.168.1.1 255.255.255.0 on VLAN 1,
and address mode:       DHCP

Console#
```

Sending Simple Mail Transfer Protocol Alerts

```
Console(config)# logging sendmail host 192.168.1.4
Console(config)# logging sendmail level 3
Console(config)# logging sendmail source-email kentk@planet.com.tw

Console(config)# logging sendmail destination-email supports@planet.con.tw
Console(config)# logging sendmail
Console(config)# exit
Console# show logging sendmail
```

```
SMTP servers
1. 192.168.1.4
SMTP minimum severity level: 4
SMTP destination email addresses
1. supports@planet.com.tw
SMTP source email address: kentk@planet.com.tw
SMTP status:                Enabled
Console#
```

Setting the System Clock

```
Console(config)#sntp server 10.1.0.19 137.82.140.80 128.250.36.2
Console(config)#sntp poll 60
Console(config)#sntp client
Console(config)#exit
Console#show sntp
Current time:    Jan 6 14:56:05 2004
Poll interval: 60
Current    mode: unicast
SNTP status : Enabled
SNTP server 10.1.0.19 137.82.140.80 128.250.36.2
Current server: 128.250.36.2
Console#
```

Setting the Time Zone

SNTP uses Coordinated Universal Time (or UTC, formerly Greenwich Mean Time, or GMT) based on the time at the Earth's prime meridian, zero degrees longitude. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC.

```
Console# calendar set 17 46 00 october 18 2007
Console# show calendar
 17:46:11 October 18 2007
Console#
```

7. SWITCH OPERATION

7.1 Address Table

The Switch is implemented with an address table. This address table composed of many entries. Each entry is used to store the address information of some node in network, including MAC address, port no, etc. This in-formation comes from the learning process of Ethernet Switch.

7.2 Learning

When one packet comes in from any port, the Switch will record the source address, port no. And the other related information in address table. This information will be used to decide either forwarding or filtering for future packets.

7.3 Forwarding & Filtering

When one packet comes from some port of the Ethernet Switching, it will also check the destination address besides the source address learning. The Ethernet Switching will lookup the address-table for the destination address. If not found, this packet will be forwarded to all the other ports except the port, which this packet comes in. And these ports will transmit this packet to the network it connected. If found, and the destination address is located at different port from this packet comes in, the Ethernet Switching will forward this packet to the port where this destination address is located according to the information from address table. But, if the destination address is located at the same port with this packet comes in, then this packet will be filtered. Thereby increasing the network throughput and availability

7.4 Store-and-Forward

Store-and-Forward is one type of packet-forwarding techniques. A Store-and-Forward Ethernet Switching stores the incoming frame in an internal buffer, do the complete error checking before transmission. Therefore, no error packets occurrence, it is the best choice when a network needs efficiency and stability.

The Ethernet Switch scans the destination address from the packet-header, searches the routing table pro-vided for the incoming port and forwards the packet, only if required. The fast forwarding makes the switch attractive for connecting servers directly to the network, thereby increasing throughput and availability. How-ever, the switch is most commonly used to segment existence hubs, which nearly always improves overall performance. An Ethernet Switching can be easily configured in any Ethernet network environment to signifi-cantly boost bandwidth using conventional cabling and adapters.

Due to the learning function of the Ethernet switching, the source address and corresponding port number of each incoming and outgoing packet are stored in a routing table. This information is subsequently used to filter packets whose destination address is on the same segment as the source address. This confines network traffic to its respective domain and reduce the overall load on the network.

The Switch performs "Store and forward" therefore, no error packets occur. More reliably, it reduces the re-transmission rate. No packet loss will occur.

7.5 Auto-Negotiation

The STP ports on the Switch have built-in "Auto-negotiation". This technology automatically sets the best possible bandwidth when a connection is established with another network device (usually at Power On or Reset). This is done by detect the modes and speeds at the second of both device is connected and capable of, both 10Base-T and 100Base-TX devices can connect with the port in either Half- or Full-Duplex mode.

If attached device is:	100Base-TX port will set to:
10Mbps, no auto-negotiation	**10Mbps.**
10Mbps, with auto-negotiation	**10/20Mbps (10Base-T/Full-Duplex)**
100Mbps, no auto-negotiation	**100Mbps**
100Mbps, with auto-negotiation	**100/200Mbps (100Base-TX/Full-Duplex)**

8. POWER OVER ETHERNET OVERVIEW

What is PoE?

Based on the global standard IEEE 802.3af, PoE is a technology for wired Ethernet, the most widely installed local area network technology adopted today. PoE allows the electrical power necessary for the operation of each end-device to be carried by data cables rather than by separate power cords. New network applications, such as IP Cameras, VoIP Phones, and Wireless Networking, can help enterprises improve productivity. It minimizes wires that must be used to install the network for offering lower cost, and less power failures.

IEEE802.3af also called Data Terminal equipment (DTE) power via Media dependent interface (MDI) is an international standard to define the transmission for power over Ethernet. The 802.3af is delivering 48V power over RJ-45 wiring. Besides 802.3af also define two types of source equipment: Mid-Span and End-Span.

- **Mid-Span**

  Mid-Span device is placed between legacy switch and the powered device. Mid-Span is tap the unused wire pairs 4/5 and 7/8 to carry power, the other four is for data transmit.

- **End-Span**

  End-Span device is direct connecting with power device. End-Span could also tap the wire 1/2 and 3/6.

PoE System Architecture

The specification of PoE typically requires two devices: the **Powered Source Equipment (PSE)** and the **Powered Device (PD)**. The PSE is either an End-Span or a Mid-Span, while the PD is a PoE-enabled terminal, such as IP Phones, Wireless LAN, etc. Power can be delivered over data pairs or spare pairs of standard CAT-5 cabling.

How Power is Transferred Through the Cable

A standard CAT5 Ethernet cable has four twisted pairs, but only two of these are used for 10BASE-T and 100BASE-T. The specification allows two options for using these cables for power, shown in Figure 2 and Figure 3:

The spare pairs are used. Figure 2 shows the pair on pins 4 and 5 connected together and forming the positive supply, and the pair on pins 7 and 8 connected and forming the negative supply. (In fact, a late change to the spec allows either polarity to be used).

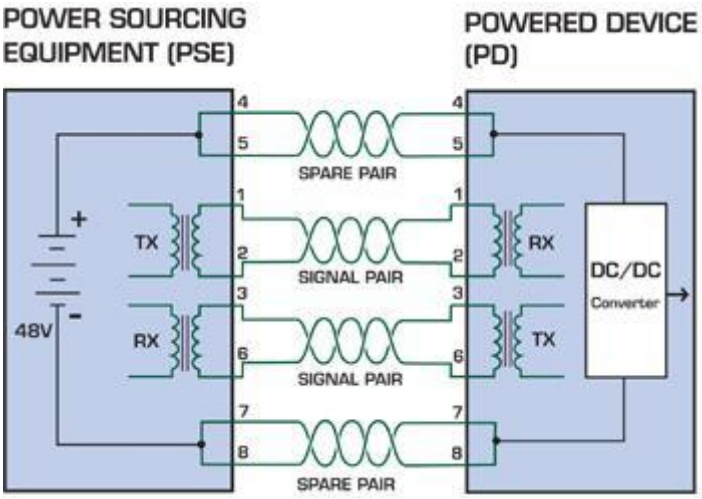


Figure 1 - Power Supplied over the Spare Pins

The data pairs are used. Since Ethernet pairs are transformer coupled at each end, it is possible to apply DC power to the center tap of the isolation transformer without upsetting the data transfer. In this mode of operation the pair on pins 3 and 6 and the pair on pins 1 and 2 can be of either polarity.

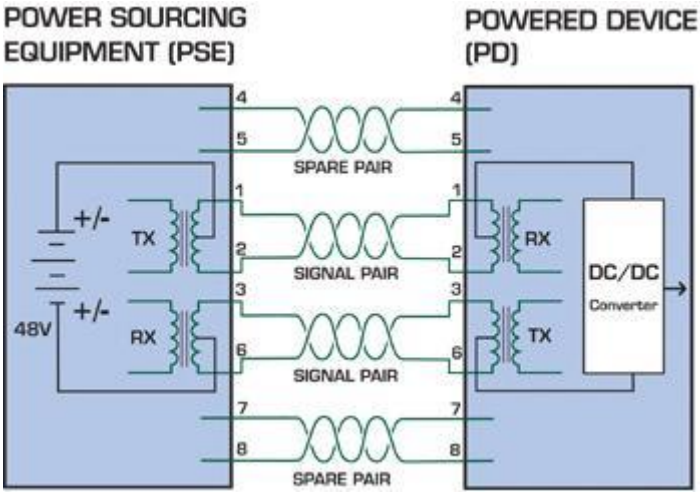


Figure 2 - Power Supplied over the Data Pins

When to install PoE?

Consider the following scenarios:

- • You're planning to install the latest VoIP Phone system to minimize cabling building costs when your company moves into new offices next month.
- • The company staff has been clamoring for a wireless access point in the picnic area behind the building so they can work on their laptops through lunch, but the cost of electrical power to the outside is not affordable.
- • Management asks for IP Surveillance Cameras and business access systems throughout the facility, but they would rather avoid another electrician's payment.

References:

IEEE Std 802.3af-2003 (Amendment to IEEE Std 802.3-2002, including IEEE Std 802.3ae-2002), 2003 Page(s):0_1-121

White Paper on Power over Ethernet (IEEE802.3af)

http://www.poweroverethernet.com/articles.php?article_id=52

Microsemi /PowerDsine

http://www.microsemi.com/PowerDsine/

Linear Tech

http://www.linear.com/

The PoE Provision Process

While adding PoE support to networked devices is relatively painless, it should be realized that power cannot simply be transferred over existing CAT-5 cables. Without proper preparation, doing so may result in damage to devices that are not designed to support provision of power over their network interfaces.

The PSE is the manager of the PoE process. In the beginning, only small voltage level is induced on the port's output, till a valid PD is detected during the Detection period. The PSE may choose to perform classification, to estimate the amount of power to be consumed by this PD. After a time-controlled start-up, the PSE begins supplying the 48 VDC level to the PD, till it is physically or electrically disconnected. Upon disconnection, voltage and power shut down.

Since the PSE is responsible for the PoE process timing, it is the one generating the probing signals prior to operating the PD and monitoring the various scenarios that may occur during operation.

All probing is done using voltage induction and current measurement in return.

Stages of powering up a PoE link

Stage	Action	Volts specified per 802.3af	Volts managed by chipset
Detection	Measure whether powered device has the correct signature resistance of 15–33 kΩ	2.7-10.0	1.8–10.0
Classification	Measure which power level class the resistor indicates	14.5-20.5	12.5–25.0
Startup	Where the powered device will startup	>42	>38
Normal operation	Supply power to device	36-57	25.0–60.0

Line Detection

Before power is applied, safety dictates that it must first be ensured that a valid PD is connected to the PSE's output. This process is referred to as "line detection", and involves the PSE seeking a specific, 25 KΩ signature resistor. Detection of this signature indicates that a valid PD is connected, and that provision of power to the device may commence.

The signature resistor lies in the PD's PoE front-end, isolated from the rest of the the PD's circuitries till detection is certified.

Classification

Once a PD is detected, the PSE may optionally perform classification, to determine the maximal power a PD is to consume. The PSE induces 15.5-20.5 VDC, limited to 100 mA, for a period of 10 to 75 ms responded by a certain current consumption by the PD, indicating its power class.

The PD is assigned to one of 5 classes: 0 (default class) indicates that full 15.4 watts should be provided, 1-3 indicate various required power levels and 4 is reserved for future use. PDs that do not support classification are assigned to class 0. Special care must be employed in the definition of class thresholds, as classification may be affected by cable losses.

Classifying a PD according to its power consumption may assist a PoE system in optimizing its power distribution. Such a system typically suffers from lack of power resources, so that efficient power management based on classification results may reduce total system costs.

Start-up

Once line detection and optional classification stages are completed, the PSE must switch from low voltage to its full voltage capacity (44-57 Volts) over a minimal amount of time (above 15 microseconds).

A gradual startup is required, as a sudden rise in voltage (reaching high frequencies) would introduce noise on the data lines.

Once provision of power is initiated, it is common for inrush current to be experienced at the PSE port, due to the PD's input capacitance. A PD must be designed to cease inrush current consumption (of over 350 mA) within 50 ms of power provision startup.

Operation

During normal operation, the PSE provides 44-57 VDC, able to support a minimum of 15.4 watts power.

Power Overloads

The IEEE 802.3af standard defines handling of overload conditions. In the event of an overload (a PD drawing a higher power level than the allowed 12.95 Watts), or an outright short circuit caused by a failure in cabling or in the PD, the PSE must shut down power within 50 to 75 milliseconds, while limiting current drain during this period to protect the cabling infrastructure. Immediate voltage drop is avoided to prevent shutdown due to random fluctuations.

Power Disconnection Scenarios

The IEEE 802.3af standard requires that devices powered over Ethernet be disconnected safely (i.e. power needs be shut down within a short period of time following disconnection of a PD from an active port).

When a PD is disconnected, there is a danger that it will be replaced by a non-PoE-ready device while power is still on. Imagine disconnecting a powered IP phone utilizing 48 VDC, then inadvertently plugging the powered Ethernet cable into a non-PoE notebook computer. What's sure to follow is not a pretty picture.

The standard defines two means of disconnection, DC Disconnect and AC Disconnect, both of which provide the same

functionality - the PSE shutdowns power to a disconnected port within 300 to 400ms. The upper boundary is a physical human limit for disconnecting one PD and reconnecting another.

DC Disconnect

DC Disconnect detection involves measurement of current. Naturally, a disconnected PD stops consuming current, which can be inspected by the PSE. The PSE must therefore disconnect power within 300 to 400 ms from the current flow stop. The lower time boundary is important to prevent shutdown due to random fluctuations.

AC Disconnect

This method is based on the fact that when a valid PD is connected to a port, the AC impedance measured on its terminals is significantly lower than in the case of an open port (disconnected PD).

AC Disconnect detection involves the induction of low AC signal in addition to the 48 VDC operating voltage. The returned AC signal amplitude is monitored by the PSE at the port terminals. During normal operation, the PD's relatively low impedance lowers the returned AC signal while a sudden disconnection of this PD will cause a surge to the full AC signal level and will indicate PD disconnection.

9. TROUBLE SHOOTING

This chapter contains information to help you solve problems. If the Ethernet Switch is not functioning properly, make sure the Ethernet Switch was set up according to instructions in this manual.

■ **The Link LED is not lit**

Solution:

Check the cable connection and remove duplex mode of the Ethernet Switch

■ **Some stations cannot talk to other stations located on the other port**

Solution:

Please check the VLAN settings, trunk settings, or port enabled / disabled status.

■ **Performance is bad**

Solution:

Check the full duplex status of the Ethernet Switch. If the Ethernet Switch is set to full duplex and the partner is set to half duplex, then the performance will be poor. Please also check the in/out rate of the port.

■ **Why the Switch doesn't connect to the network**

Solution:

1. Check the LNK/ACT LED on the switch
2. Try another port on the Switch
3. Make sure the cable is installed properly
4. Make sure the cable is the right type
5. Turn off the power. After a while, turn on power again

■ **100Base-TX port link LED is lit, but the traffic is irregular**

Solution:

Check that the attached device is not set to dedicate full duplex. Some devices use a physical or software switch to change duplex modes. Auto-negotiation may not recognize this type of full-duplex setting.

APPENDEX A

A.1 Switch's RJ-45 Pin Assignments

1000Mbps, 1000Base T

Contact	MDI	MDI-X
1	BI_DA+	BI_DB+
2	BI_DA-	BI_DB-
3	BI_DB+	BI_DA+
4	BI_DC+	BI_DD+
5	BI_DC-	BI_DD-
6	BI_DB-	BI_DA-
7	BI_DD+	BI_DC+
8	BI_DD-	BI_DC-

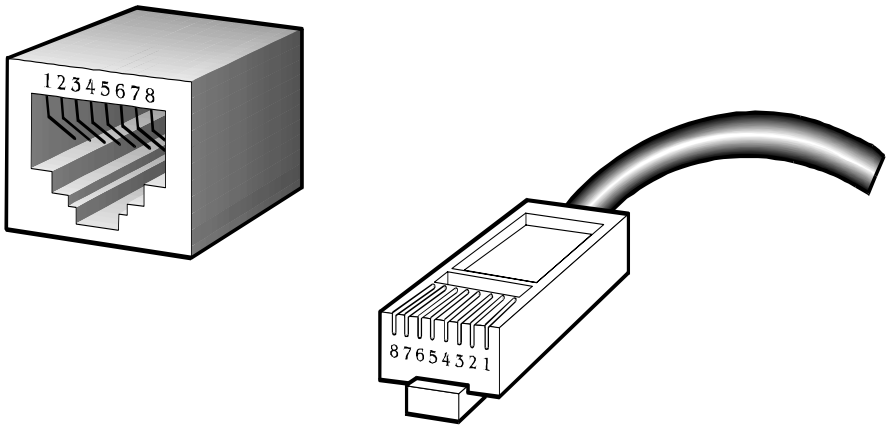
Implicit implementation of the crossover function within a twisted-pair cable, or at a wiring panel, while not expressly forbidden, is beyond the scope of this standard.

A.2 10/100Mbps, 10/100Base-TX

When connecting your 10/100Mbps Ethernet Switch to another switch, a bridge or a hub, a straight or crossover cable is necessary. Each port of the Switch supports auto-MDI/MDI-X detection. That means you can directly connect the Switch to any Ethernet devices without making a crossover cable. The following table and diagram show the standard RJ-45 receptacle/ connector and their pin assignments:

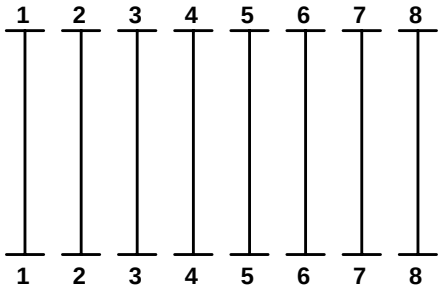
RJ-45 Connector pin assignment		
Contact	**MDI** **Media Dependant Interface**	**MDI-X** **Media Dependant Interface-Cross**
1	**Tx + (transmit)**	**Rx + (receive)**
2	**Tx - (transmit)**	**Rx - (receive)**
3	**Rx + (receive)**	**Tx + (transmit)**
4, 5	**Not used**	
6	**Rx - (receive)**	**Tx - (transmit)**
7, 8	**Not used**	

The standard cable, RJ-45 pin assignment

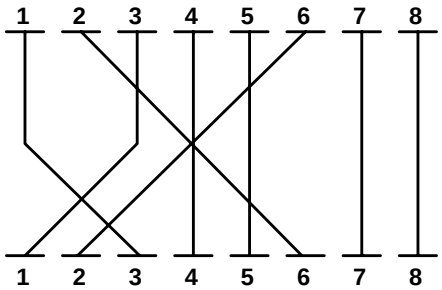


The standard RJ-45 receptacle/connector

There are 8 wires on a standard UTP/STP cable and each wire is color-coded. The following shows the pin allocation and color of straight cable and crossover cable connection:



Straight Cable	**SIDE 1**	**SIDE2**
SIDE 1	**1 = White / Orange**	**1 = White / Orange**
	2 = Orange	**2 = Orange**
	3 = White / Green	**3 = White / Green**
	4 = Blue	**4 = Blue**
	5 = White / Blue	**5 = White / Blue**
	6 = Green	**6 = Green**
	7 = White / Brown	**7 = White / Brown**
SIDE 2	**8 = Brown**	**8 = Brown**



Straight Cable	**SIDE 1**	**SIDE2**
SIDE 1	**1 = White / Orange**	**1 = White / Orange**
	2 = Orange	**2 = Green**
	3 = White / Green	**3 = White / Orange**
	4 = Blue	**4 = Blue**
	5 = White / Blue	**5 = White / Blue**
	6 = Green	**6 = Orange**
	7 = White / Brown	**7 = White / Brown**
SIDE 2	**8 = Brown**	**8 = Brown**

Figure A-1: Straight-Through and Crossover Cable

Please make sure your connected cables are with same pin assignment and color as above picture before deploying the cables into your network.

APPENDEX B : GLOSSARY

Bandwidth Utilization

The percentage of packets received over time as compared to overall bandwidth.

BOOTP

Boot protocol used to load the operating system for devices connected to the network.

Distance Vector Multicast Routing Protocol (DVMRP)

A distance-vector-style routing protocol used for routing multicast datagrams through the Internet. DVMRP combines many of the features of RIP with Reverse Path Broadcasting (RPB).

GARP VLAN Registration Protocol (GVRP)

Defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports along the Spanning Tree so that VLANs defined in each switch can work automatically over a Spanning Tree network.

Generic Attribute Registration Protocol (GARP)

GARP is a protocol that can be used by endstations and switches to register and propagate multicast group membership information in a switched environment such that multicast data frames are propagated only to those parts of a switched LAN containing registered endstations. Formerly called Group Address Registration Protocol.

Group Attribute Registration Protocol

See Generic Attribute Registration Protocol.

Generic Multicast Registration Protocol (GMRP)

GMRP allows network devices to register end-stations with multicast groups. GMRP requires that any participating network devices or end-stations comply with the IEEE 802.1p standard.

ICMP Router Discovery

ICMP Router Discovery message is an alternative router discovery method that uses a pair of ICMP messages on multicast links. It eliminates the need to manually configure router addresses and is independent of any specific routing protocol.

Internet Control Message Protocol (ICMP)

Commonly used to send echo messages (i.e., Ping) for monitoring purposes.

IEEE 802.1D

Specifies a general method for the operation of MAC bridges, including the Spanning Tree Protocol.

IEEE 802.1Q

VLAN Tagging—Defines Ethernet frame tags which carry VLAN information. It allows switches to assign end-stations to different virtual LANs, and defines a standard way for VLANs to communicate across switched networks.

IEEE 802.3ac

Defines frame extensions for VLAN tagging.

Internet Group Management Protocol (IGMP)

A protocol through which hosts can register with their local router for multicast services. If there is more than one multicast router on a given subnetwork, one of the routers is elected "querier" and assumes the responsibility of keeping track of group membership.

IGMP Snooping

Listening to IGMP Query and IGMP Report packets transferred between IP Multicast Routers and IP Multicast host groups to learn IP Multicast group members.

In-Band Management

Management of the network from a station attached directly to the network.

IP Multicast Filtering

A process whereby this switch can pass multicast traffic along to participating hosts.

Layer 2

Data Link layer in the ISO 7-Layer Data Communications Protocol. This is directly related to the hardware interface for network devices and passes traffic based on MAC addresses.

Layer 3

Network layer in the ISO 7-Layer Data Communications Protocol. This layer handles the routing functions for data moving from one open system to another.

Link Aggregation

See Port Trunk.

Management Information Base (MIB)

An acronym for Management Information Base. It is a set of database objects that contains information about a specific device.

Multicast Switching

A process whereby the switch filters incoming multicast frames for services no attached host has registered for, or forwards them to all ports contained within the designated multicast VLAN group.

Open Shortest Path First (OSPF)

OSPF is a link state routing protocol that functions better over a larger network such as the Internet, as opposed to distance vector routing protocols such as RIP. It includes features such as unlimited hop count, authentication of routing updates, and Variable Length Subnet Masks (VLSM).

Out-of-Band Management

Management of the network from a station not attached to the network.

Port Mirroring

A method whereby data on a target port is mirrored to a monitor port for troubleshooting with a logic analyzer or RMON probe. This allows data on the target port to be studied unobtrusively.

Port Trunk

Defines a network link aggregation and trunking method which specifies how to create a single high-speed logical link that combines several lower-speed physical links.

Remote Monitoring (RMON)

RMON provides comprehensive network monitoring capabilities. It eliminates the polling required in standard SNMP, and can set alarms on a variety of traffic conditions, including specific error types.

Routing Information Protocol (RIP)

The RIP protocol attempts to find the shortest route to another device by minimizing the distance vector, or hop count, which serves as a rough estimate of transmission cost. RIP-2 is a compatible upgrade to RIP. It adds useful capabilities for subnet routing, authentication, and multicast transmissions.

Simple Network Management Protocol (SNMP)

The application protocol offering network management services in the Internet suite of protocols.

Serial Line Internet Protocol (SLIP)

Serial Line Internet Protocol, a standard protocol for point-to-point connections using serial lines.

Spanning Tree Protocol (STP)

A technology that checks your network for any loops. A loop can often occur in complicated or back-up linked network systems. Spanning-tree detects and directs data along the shortest path, maximizing the performance and efficiency of the network.

Telnet

Defines a remote communication facility for interfacing to a terminal device over TCP/IP.

Trivial File Transfer Protocol (TFTP)

A TCP/IP protocol commonly used for software downloads.

Virtual LAN (VLAN)

A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, allowing users to share information and resources as though located on the same LAN.

XModem

A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

EC Declaration of Conformity

For the following equipment:

*Type of Product: 24-Port 10/100Mbps + 4 Gigabit TP / SFP Managed Security Switch
*Model Number: SGSW-2840

* Produced by:
Manufacturer's Name : **Planet Technology Corp.**
Manufacturer's Address: 11F, No 96, Min Chuan Road
Hsin Tien, Taipei, Taiwan , R. O.C.

is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility Directive on (89/336/EEC).
For the evaluation regarding the EMC, the following standards were applied:

Emission	EN 55022	(1998/A1 + 2000/A2:2003 Class A)
Harmonic	EN 61000-3-2	(2006)
Flicker	EN 61000-3-3	(1995/A1: 2001/A2:2005)
Immunity	EN 55024	(1998/A1: 2001/A2:2003)
ESD	IEC 61000-4-2	(2001)
RS	IEC 61000-4-3	(2002)
EFT/ Burst	IEC 61000-4-4	(2004)
Surge	IEC 61000-4-5	(2001)
CS	IEC 61000-4-6	(2003) + A1 (2004)
Magnetic Field	IEC 61000-4-8	(2001)
Voltage Disp	IEC 61000-4-11	(2004)

Responsible for marking this declaration if the:

☒ **Manufacturer** ☐ **Authorized representative established within the EU**

Authorized representative established within the EU (if applicable):

Company Name: **Planet Technology Corp.**

Company Address: **11F, No.96, Min Chuan Road, Hsin Tien, Taipei, Taiwan, R.O.C**

Person responsible for making this declaration

Name, Surname **Kent Kang**

Position / Title : **Product Manager**

Taiwan	**29th Aug, 2008**	Kent Kang
Place	*Date*	*Legal Signature*

EC Declaration of Conformity

For the following equipment:

*Type of Product: 8-Port 10/100Mbps Fast Ethernet + 2 Gigabit TP/ SFP combo Managed Ethernet Switch
*Model Number: SGSD-1022

* Produced by:
Manufacturer's Name : **Planet Technology Corp.**
Manufacturer's Address: 11F, No 96, Min Chuan Road
Hsin Tien, Taipei, Taiwan , R. O.C.

is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility Directive on (89/336/EEC).
For the evaluation regarding the EMC, the following standards were applied:

Emission	EN 55022	(1998/A1 + 2000/A2:2003 Class A)
Harmonic	EN 61000-3-2	(2006)
Flicker	EN 61000-3-3	(1995/A1: 2001/A2:2005)
Immunity	EN 55024	(1998/A1: 2001/A2:2003)
ESD	IEC 61000-4-2	(2001)
RS	IEC 61000-4-3	(2002)
EFT/ Burst	IEC 61000-4-4	(2004)
Surge	IEC 61000-4-5	(2001)
CS	IEC 61000-4-6	(2003) + A1 (2004)
Magnetic Field	IEC 61000-4-8	(2001)
Voltage Disp	IEC 61000-4-11	(2004)

Responsible for marking this declaration if the:

☒ **Manufacturer** ☐ **Authorized representative established within the EU**

Authorized representative established within the EU (if applicable):

Company Name: **Planet Technology Corp.**

Company Address: **11F, No.96, Min Chuan Road, Hsin Tien, Taipei, Taiwan, R.O.C**

Person responsible for making this declaration

Name, Surname **Kent Kang**

Position / Title : **Product Manager**

Taiwan	**29th Aug, 2008**	Kent Kang
Place	*Date*	*Legal Signature*